fine tuning's

PROCEEDINGS 1990

The 1990 front cover was designed by Proceedings Senior Editor John Bryant. It is a brief visual study of how the artists of major world cultures represented members of that culture.

The cultures represented are:

Row 1: Renaissance Italy, Hellenic Greece, Pre-contact Polynesia, and Feudal Japan.

Row 2: Renaissance Italy, Ist Generation Electronics, Imperial Rome, Pre-Incan Andean.

Row 3: Mayan America, 16th C. West Africa, 2nd Generation Electronics, Renaissance Italy.

Row 4: Imperial Egypt, Hellenic Greece, Modern Europe, Renaissance Italy.

Each of the images was scanned into digital memory using the HP Scan Jet scanner and HP Scanning Gallery software. The output was printed using a NEC LC 890 SilentWriter LC 890 laser printer.

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International Standard Book Number application has been filed.

table of contents

table of contents

introduction

about fine funing

propagation

P.3 Notes on Tropical Band Propagation ..... John Bryant
David Clark

antennas

A.10 T2FD - The Forgotten Antenna ..... Guy Atkins

A.11 Shortwave Direction Finding: Getting Started ..... Joe Farley
Mitch Sams

receivers

R.13 Antique Communications Receivers:
Collecting and Restoring Techniques ..... Chuck Dachis

R.14 Getting the Most Out of ECSS ..... Gene Pearson

R.15 Synchronous Detection ..... Craig Siegenthaler

R.16 A Review of the Kenwood R-5000 ..... Don Moore
Kent Willis

R.17 Modifying the Sony ICF 2010/2001D
A Compendium ..... Gordon Darling

peripheral equipment

PE.14 Adding a Keypad Controller ..... Guy Atkins

PE.15 The Sony Walkman Pro WM-D6C ..... Chuck Mitchell

PE.16 The Datong FL-3 Multimode Filter ..... Rowland Archer

table of contents (cont.....)

features

F.15 The Library as a DX Reference Tool.....Don Moore
John Bryant

F.16 International Medium Wave DXing
From Western North America.....Bruce Portzer

F.17 DXing On The Road
A Compendium.....Rowland Archer

F.18 DXpeditions
A Compendium.....Nick Hall-Patch

F.19 A DXers Tour of Central America.....Rich D'Angelo

F.20 Shortwave Radio from the:
African Sahara and Sahel.....Harold Cones

about the authors and editors

introduction

introduction

Welcome to the 1990 Edition of **fine tuning's** PROCEEDINGS, the third annual volume of articles written by and for experienced shortwave DXers. When **fine tuning** first began work on this project in 1987, we hoped to establish a forum which could provide a stable intellectual and informational underpinning to the hobby of SWBC DXing. By trusting other organizations to fulfill the very important role of educating beginning and casual radio enthusiasts, we felt that PROCEEDINGS could be free to publish in-depth advanced articles of merit and interest to those who have made a long-term commitment to the avocation of radio. We hoped that the existence of such a forum might actually foster advancements in the radio hobbies. Today, we feel that those goals and more are being fulfilled. Few, if any, of 1990's major articles would have been attempted if the forum of PROCEEDINGS did not exist. It is a great privilege for us on the staff to feel that we are contributing to the advancement of the state-of-the-art. We hope that each article in PROCEEDINGS 1990 meets at least one of our three major content goals:

A) Provide a forum for "cutting edge" articles which may advance the state-of-the-art.
B) Provide material relevant to experienced radio enthusiasts which is not available elsewhere.
C) Raise the level of discourse about the avocation of radio.

One of our other goals was to help break down the artificial but very real intellectual barriers between the various radio hobbies, i.e. SW DXing, MW DXing and Amateur Radio. PROCEEDINGS, as an institution, appears to be doing just that. The Editorial Review Board and our authors come from the leadership of both the MW and SW DX communities and a number are also amateur radio operators. The readers of PROCEEDINGS are equally cosmopolitan in their radio-related interests with many radio amateurs and MW DXers joining SWBCers as fans of PROCEEDINGS. As our financial and administrative structure have begun to stabilize, and the readership and support from the radio community continues to grow, we look forward to **fine tuning's** PROCEEDINGS continuing to serve the radio hobbies for years to come.

1988 AND 1989 EDITIONS

Even though each edition of **fine tuning's** PROCEEDINGS was designed to be a long-term reference for radio enthusiasts, we originally planned to keep each edition of PROCEEDINGS "in print" only for 12 months. This was primarily a financial decision; we are a small organization and are totally without capital funds. Bluntly, printing 50 to 100 "extra" copies to keep as long term stock would tie up $1000 to $2000 that we simply do not have. Naively, we hoped that "everyone" would hear about PROCEEDINGS in its first year and buy a copy. We were happily mistaken; it seems that new radio people, both here and abroad, are continuing to discover PROCEEDINGS. If they find the current edition useful, and most do, many want to purchase the previous year's issue. Thus a modest level of demand continues for PROCEEDINGS 1988.

To respond to that, we are announcing a third "final" print run of the 1988 volume. We will ask our printer to make a very small run to meet all orders which reach us by 1 October, 1990. If finances allow, we will order a few 1988 volumes for stock, also.

With the success of the 1989 edition, we plan to keep it in print for at least two years. We hope to make the same commitment to the 1990 edition.

EDITORIAL PROCESS

Since the editorial process of PROCEEDINGS is unique in hobby journalism, it might be of some interest to readers. First, where do the authors and articles come from? Mostly, they are recruited by the editorial staff, though some of our very best articles also come from volunteers or arrive unsolicited. Rough drafts are submitted in March of each year and then take a twin track through the editorial process. One track runs straight through downtown Hawarden, Iowa, where Reverend Fritz Mellberg edits all articles (except this!) for style, conciseness and clarity. Among the authors, Rev. Mellberg is known as "Fritz the Chopper." A journalist before answering a higher call, Fritz is responsible for helping us communicate intelligibly with each of you. The second editorial track runs through a Distributing Editor to six or so members of the Editorial Review Board and at least two of the five staff. The Distributing Editor, this year David Clark, assigns review responsibilities very carefully. Of the six or so reviewers, one or two are selected for their own expertise in the article's subject; several are chosen to represent the "average" reader, and one is specifically chosen who neither knows nor cares much about the subject at hand. The Editorial Review Board is responsible for maintaining the standard of excellence for which PROCEEDINGS is known. At the Board's suggestion, several articles were withheld from publication again this year. These withheld articles, by very respected figures in the hobby, just simply required more development before publication. We are very grateful that most authors who receive such news do so with grace and are willing to put forth more effort on what we all believe are important projects. The second and probably more important role of the Review Board is to assist each author with constructive suggestions and comments so that the final article may have the benefit of the ideas and knowledge of several experienced DXers.

The "peer review" process of PROCEEDINGS is, we believe, unique in hobby journalism. It is unashamedly copied from the quality control process of the most respected scholarly and learned publications. We believe that this elaborate, expensive, and rather ego-deflating process insures that the articles finally published in PROCEEDINGS are truly the best the hobby has to offer. We hope you agree.

WHO DID WHAT...

The PROCEEDINGS staff organization was a bit unusual this year since our "quarterback" was on the road most of the nine-month-long production. John Bryant, normally a Professor of Architecture at Oklahoma State University, was on sabbatical leave studying at the East Asian Library, University of Washington, Seattle. About half the time, John and his wife were living on Lopez Island in the San Juans, and half the time they were camped out at various parks around the Northwest. Although John continued to provide overall administration, his erratic schedule made hands-on management impossible. To fill the gap, Guy Atkins became our "back-up quarterback." Guy, also located in the Seattle area, provided on the spot decision making, served as John's contact point with "the real world," and handled all PROCEEDINGS publicity. David Clark took over the complex and sensitive job of Distribution Editor to the Review Board, and continued to be PROCEEDINGS' greatest advocate in the northern half of the continent. And Fritz continued to guide us all toward intelligible writing. Readers and authors alike owe Fritz a real debt for his professional editing of some very difficult material.

Our newest PROCEEDINGS staff member is Kevin Atkins of Pinson, Alabama. Kevin's name is familiar to most of our readers since he is a prolific DXer and also very active in other aspects of the hobby: he serves as one of the four primary editors of **fine tuning's** newsletter, and as the chair of the Graphics Committee of NASWA. He was kind enough to join the PROCEEDINGS staff and lead the effort to upgrade our graphics and reproduction. Midway through the print runs of PROC 89, we changed to a much higher quality printer located near Kevin. Starting with the first print run of this edition, all photographs will be "screened" by Kevin and should reproduce much more legibly. Thanks Kevin and Welcome Aboard!

FINANCES AND SUCH

As far as we know, our financial structure is unique. No one involved in PROCEEDINGS--authors, Editorial Review Board members or Staff--is compensated financially. Further, every one of us purchased, at full price, our own copies of PROCEEDINGS. The people involved did so to insure that this book could continue to act as an intellectual base for the furtherance of the hobby. The financial concerns of modern publishing, particularly of books structured as this one is, are merciless. The wide-ranging review process is very expensive, costing several thousand dollars of photocopying, mailing and long distance telephone charges. Further, since our hobby is so small and the number in our hobby able to afford PROCEEDINGS smaller yet, low volume, expensive print runs are required. The increasing success of the 1989 volume allowed us to repay the debts incurred in our first year. Our slight financial residual from 1989 has been reinvested in better printing and photo reproduction of this edition, as noted. Thanks to all involved and to the support of our readers, careful management should allow PROCEEDINGS to continue to "break even" in future years!

IN APPRECIATION

First and foremost, we would like to thank our readers for their enthusiastic support. That support, expressed through letters and in conversations at meetings, makes all of the work worthwhile. Thank you very much for your continued support.

We would also like to thank a number of prominent individuals and organizations for their help and continuing support of the PROCEEDINGS effort: Jonathan Marks of Radio Nederland, Ian MacFarland of Radio Canada Intl, Brent Allred of HCJB, Bob Brown of NASWA and the ANARC SWL net, Glenn Hauser, Goran Eriksson of Swedish DX-Kop, Arthur Ward of World Radio Club, Larry Magne, David Newkirk of QST, and of course, Gerry Dexter and Don Jensen.

Finally, the production of PROCEEDINGS 1990 was a real joy for the staff. It is a wonderful experience to work with some of the best minds in the hobby as they wrestle with the difficult task of writing. It is almost magical to watch rough ideas turn into thoroughly developed and clearly written articles. We are sure that many of these articles will be helpful to the hobby for years to come.

WELCOME TO PROCEEDINGS 1990!

John Bryant Fritz Menberg David Clark Guy Atkins Kevin Atkins

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about fine tuning

about fine tuning

fine tuning is an organization dedicated to supporting the hobby of Shortwave Broadcast DX. Founded in 1977 by well known DXer Dan Ferguson, FT originally published a bi-weekly newsletter of rare and difficult DX heard by leading shortwave enthusiasts throughout North America. To shorten the time between reception and publication, and to keep the work load manageable, membership in fine tuning was kept small and "by invitation." After a number of years, Dan turned over the editing and publishing chores to Larry Yamron who continues to serve as FT's publisher.

In 1986, FT merged with the Ozark Mountain DX Club, a fully public DX newsletter founded and published by Mitch Sams. Mitch is now the Managing Editor of **fine tuning**. With the merger, FT adopted the "open organization" philosophy of OMDXC and continues today to welcome all radio enthusiasts interested in rare and difficult DX. Also in 1986, FT established its Special Publications arm led by John Bryant.

The newsletter portion of **fine tuning**'s services is published weekly during the DX season and bi-weekly during the North American summer. The bulletin, also called **fine tuning**, is a journal emphasizing rare and difficult DX. The bulletins focus on SWBC news but also contain news of unusual merit from the medium wave, long wave, ham, utility, or TV DX communities.

There are eight people currently involved in the production of the weekly issues of fine tuning. Four outstanding DXers serve as editors, each being responsible for two issues before handing off to the next editor. The weekly editors are: Dave Valco, Kirk Allen, Kevin Atkins and Alan Laves. They are supported by Back-up Editor John Wilkens. Managing Editor Mitch Sams maintains FT subscriptions, finances, the subscriber list, mailing labels and responds to sample requests. Publication of FT is handled by Larry Yamron. Each completed issue of FT is mailed from the current editor to Larry for publication and mailing. The staff of **fine tuning**'s Special Publications consists of John Bryant and Guy Atkins. Larry Yamron also joins this part of FT overseeing production of DXer's Guide to Latin America. Jon Williams serves this arm of FT as well as manager of the FT/OZDX Indonesian Database.

Cost (US) per issue of the **fine tuning** bulletin is 60 cents in North America and 75 cents elsewhere (airmail). Minimum order of 20 issues ($12) is payable to:

FINE TUNING
PO Box 780075
Wichita, KS 67278 USA

Sample copies of the **fine tuning** bulletin may be obtained for an SASE.

propagation

NOTES ON TROPICAL BAND PROPAGATION

John Bryant David Clark

FOREWORD

In the past thirty years, there have been surprisingly few serious articles and only two "non-professional" books published which attempt to address the propagational needs/concerns of the Tropical Band DXer. There are three books familiar to many veteran DXers which form the intellectual foundation of serious propagation discussions in the radio hobby community today. They are:

* IONOSPHERIC RADIO COMMUNICATION, published in 1962, by the US Dept. of Commerce.

* THE SHORTWAVE PROPAGATION HANDBOOK, edited by Jacobs and Cohen and first published in 1979, by CQ Magazine.

* LOW BAND DXING, by ON4UN John Devoldere and published in 1986 by the ARRL.

Each of these references is highly recommended. However, for Tropical Band DXers, each suffers deficiencies. The Department of Commerce text is well written and quite understandable. Still it suffers from age, for much progress has been made in the 30 years since its publication. The Jacobs/Cohen book is also becoming rather dated. Further, the book is biased toward the upper half of the HF spectrum and little time is spent on the special characteristics of the lower shortwave frequencies. However, it is unparalleled as a beginning propagational text. The publication of LOW BAND DXING in the late 1980's did advance the state of the art but it offers only a small portion on propagation.

Tropical Band propagation (2 to 6 MHz) has been largely ignored as a research subject by governments and academia. In the years since WWII, most research interest has focused on either UHF (radar, telemetry) or VLF (military) propagation.

There is also a grand tradition in the hobby which states that professional writing and research is oriented to the "normal" propagational modes in use 90% of the time and to strong signal propagation, whereas Tropical Band DXers are interested in weak signal propagation and in the 10% of propagation that is NOT typical. The authors have come to believe that this attitude simply allowed experienced DXers to rationalize the fact that the behavior of the ionosphere, as they observed it, did not fit conventional models of ionospheric propagation. Had that tradition not existed, we all might have questioned some of the basic theoretical premises of conventional propagation sooner.

The authors do not question current theory concerning the basic refractory interaction between radio waves and a diffuse, ionized atmosphere. We note, however, that in the past decade some professionals and some members of the hobby community have come to feel that the conventional model of HF ionospheric radio propagation is, itself, badly flawed.

The purpose of this article is to bring to the hobby community current thinking as it relates to the conventional model of propagation and to begin discussions which will, we hope, lead to greater dialogue in the hobby and eventually, a more useful understanding of Tropical Band propagation. We will first "sketch" the state (as of 1990) of scientific understanding about the physical nature of the ionosphere as it affects Tropical Band propagation. Secondly, we will state the conventional view of Tropical Band Propagation as clearly and simply as possible. In our study, we have searched the literature of the other branches of the radio hobby to identify any material which could shed more light on our murky subject. We were successful and offer an article by well-known amateur radio DXer Yuri Blanarovich. Finally, we have attempted to point the way to a more useful working model of propagation for the Tropical Band enthusiast.

We would caution that this article is not intended to be an all-inclusive study of Tropical Band propagation. For example, the reader will not find an in-depth discussion of solar terrestrial aspects such as the sunspot cycle or the cause and effect of ionospheric and geomagnetic storms. Rather, attention has been focussed on the geophysical characteristics of the ionosphere and the interaction of HF radio waves between the earth and the refracting medium.

This article is structured in Sections which are intended to serve as logical building blocks from one to the next. However, due to the length and complexity of some of the material presented, we have adopted the use of "Abstracts" to summarize the central theme and content of each of the respective major Sections.

In undertaking this discussion and those sure to follow, the authors strongly encourage all parties to adopt clear definitions of several terms whose sloppy use has clouded much hobby literature. Among these is the term "graylining." Terrestrial physicists, astronomers and most amateur radio operators would agree that "grayline propagation" is the proper term only when BOTH the transmitter and the receiver are in the planet's "twilight zone." This obtuse issue, along with the definitions of the other four forms of twilight-related propagation enhancement will be addressed in Section B. Even experts such as John DeVoldere tend to intermix these terms at times. This confusion makes logical analysis and even communication difficult. As well, many of us have come to speak of "the width of the grayline" as a variable phenomenon: narrower at the Equator and wider at polar latitudes. We will address why we feel that perception is dangerously flawed.

The terms "refraction", "reflection," and "deflection" are used interchangeably by some professional propagational authorities while others have very precise definitions for each term. We suggest that all signal bending in the ionosphere be referred to as REFRACTION. All "bounces" off the surface (to the extent such exist) will be called REFLECTION. The term DEFLECTION will be avoided as much as possible.

Several terms are introduced which may be unfamiliar, even to seasoned DXers, and they will be dealt with carefully if they are central to this article. Other unfamiliar terms may be found in references excerpted from professional work. These will be defined if necessary to the main thrust of the material.

The point of this whole effort is to help us all hear the DX we want to hear on a more predictable basis. Some of the following discussions reinforce long-held views. Others call into question some basic propagational assumptions which have endured for decades. In either case, we will try to be simple and clear in our discussion and we will state our sources. Our objective is to apply the most recent scientific research and thinking to everyday Tropical Band DXing problems and experiences.

A TROPICAL BAND DXER'S GUIDE TO THE IONOSPHERE: THE BIG PICTURE

ABSTRACT -

The historical foundation of ionospheric research with attention to the evolution of the well-entrenched multi-hop model of HF propagation is traced. An excerpted description of the geophysical structure and diurnal characteristics of the layers of the ionosphere is also provided.

The authors introduce the concept of Spherical Divergence and Convergence as an important determinant in the eventual strength of a received signal, demonstrating that the strength will vary inversely with distance travelled beyond 6,250 miles. This concept is coupled with tilt zone mechanics as a fundamental basis for twilight enhancement of Tropical Band signals.

Referencing a little-known action taken in 1978 by the ITU/CCIR, the probability of long haul propagation occurring without intermediate ground reflection points is introduced.

INTRODUCTION

The ionosphere is that portion of the earth's atmosphere which makes long range transmission and reception of radio signals possible. Its particular character at every point along the transmission path is critical to all who are interested in radio communication, and most especially to those who are concerned with the propagation of relatively weak signals over planetary distances.

As the physical sciences developed rapidly between 1880-1930, a number of startling discoveries and the conclusions drawn from them gave theoretical underpinning to the emerging field of radio propagation. In the late 19th century, Heinrich Hertz demonstrated that radio waves travel in straight lines. But in 1901, Guglielmo Marconi became the first transatlantic DXer and his signals hardly travelled in a straight line! The next year, independent studies by Arthur Kennelly (U.S.) and Oliver Heaviside (U.K.) suggested that the upper atmosphere consisted of an electrically conducting region that "deflected" signals across the Atlantic.

In the 1920's, a British research group led by Sir Edward Appleton established conclusively that radio signals from a nearby transmitter were "reflected" off something in the upper atmosphere. The conventional view of the physical means of long distance propagation of shortwave signals developed from that seminal work.

Stated simply, this conventional model of shortwave propagation (all frequencies from 2 to 30 MHz) holds that the radio waves from a transmitter are refracted off the ionosphere and returned to earth. Propagation over long distances takes place via multiple "hops", with the refracted downward wave being bounced (reflected) off the earth and returned to the ionosphere for yet-another hop. Most texts also mention the Chordal Hop and Whispering Gallery modes of propagation, but these are spoken of as rare and exceptional cases. These modes will be examined in Section B.

GENERAL DESCRIPTION

From those early experiments by the pioneers and similar efforts continuing to the present time, we have come to know the generalized structure of the ionosphere rather well. The following excerpt from a recent scholarly paper serves to provide a foundation description:

"The ionosphere is the region of the atmosphere in which free ions and electrons exist in sufficient numbers to affect the properties of electromagnetic waves that are propagated within and through it. The ionosphere can usually be assumed to extend from about 50 to 2000 km above the earth's surface. The structure of the ionosphere is highly variable, and this variability affects the performance of communications systems whose signals are propagated by the ionosphere.

Historically, the D region of the ionosphere is treated as the lowest ionospheric region. It has an altitude range from 50 to 90 km and the electron density increases rapidly with altitude. The D region is under strong influence with maximum values of electron density occurring near local noon during summer. Between 70 and 90 km, ionization is caused primarily by solar X-rays; below 70 km, cosmic ray-produced ionization dominates. The high collision frequency between the electrons and neutral particles in the D region gives rise to substantial absorption of radio waves that are propagated into it.

The E region is the next highest ionospheric region. It spans the altitude range from about 90 to 130 km. The normal E layer closely resembles a "Chapman" layer with a maximum density near noon and a seasonal maximum in summer. The maximum density occurs near 100 km, although this height varies with local time. During the nighttime, the ionization approaches small residual levels. The normal E layer is formed by ultraviolet radiation ionizing atomic oxygen. Collisions between electrons and neutral particles, while important in the E region, are not as numerous as in the D region. The electron-neutral collision frequency generally decreases exponentially with altitude throughout the E region.

Embedded within the E region is the so-called sporadic-E layer. This layer is an anomalous ionization layer that assumes different forms - irregular and patchy, smooth and disk-like -and has little direct bearing to solar radiation. The properties of the sporadic-E layer vary substantially with location and are markedly different at equatorial, temperate and high latitudes.

The highest ionospheric region is called the F layer. The lower part of the F region (130 to 200 km) displays different variations than the upper part, and for this reason, the terms F1 and F2 (region above 200 km) are applied. The F1 region, like the E region, is under strong solar control. It reaches a maximum ionization level about one hour after local noon and its presence is generally only obvious during the summer. At night, the F1 and the F2 regions merge and are simply called the F region.

The F2 region is the highest ionospheric region. It is also the most variable in time and in space. The maximum values of electron density occur well after noon, sometimes in the evening hours. The height of the maximum ranges from 250 to 350 km at mid-latitudes and from 350 to 500 km at equatorial latitudes. At mid-latitudes, the height of maximum electron density is greater at night than in the daytime. At equatorial latitudes, the opposite behavior occurs.

The F2 region is strongly influenced by neutral-air winds, electrodynamic drift, and ambipolar diffusion that compete along with ionization processes to control the ionization distribution. The relationship between the direction of the geomagnetic field and the direction of the neutral winds and electrodynamic drifts plays a major role in F2 region structure. It is the plasma response to the dynamic processes in the presence of the geomagnetic field that gives rise to the observed variations in the F2 region.

Within the F region, the collision frequency between electrons and neutral particles decreases markedly. However, collisions between electrons and ions, being Coulomb-type collisions, can give rise to relatively high effective collision frequencies. Substantial absorption of high frequency (HF) radio waves can occur, for example, near the peak of the F region.

The F region extends upward into the topside ionosphere. The topside ionosphere is as variable as the F region, if not more so. The variations become increasingly larger with altitude. Because the electron density continuously decreases in the topside ionosphere, ionization becomes less and less important in terms of affecting most radio propagation systems.

At any location on the earth, the vertical distribution of electrons in the ionosphere can be expected to differ. Many of the ionospheric models that have been developed over the years are limited to specific geographic regions because the mechanisms that lead to the formation and changes of the ionosphere tend to vary in their dominance of the overall distribution in specific geographical regions. This is particularly true for the ionosphere in the equatorial and high latitudes." [1]

Figure A-1 depicts the major regions (layers) of the ionosphere and their relative electron densities for both

daytime and nighttime conditions. This characterization is typical for mid-latitudes at sunspot maximum.

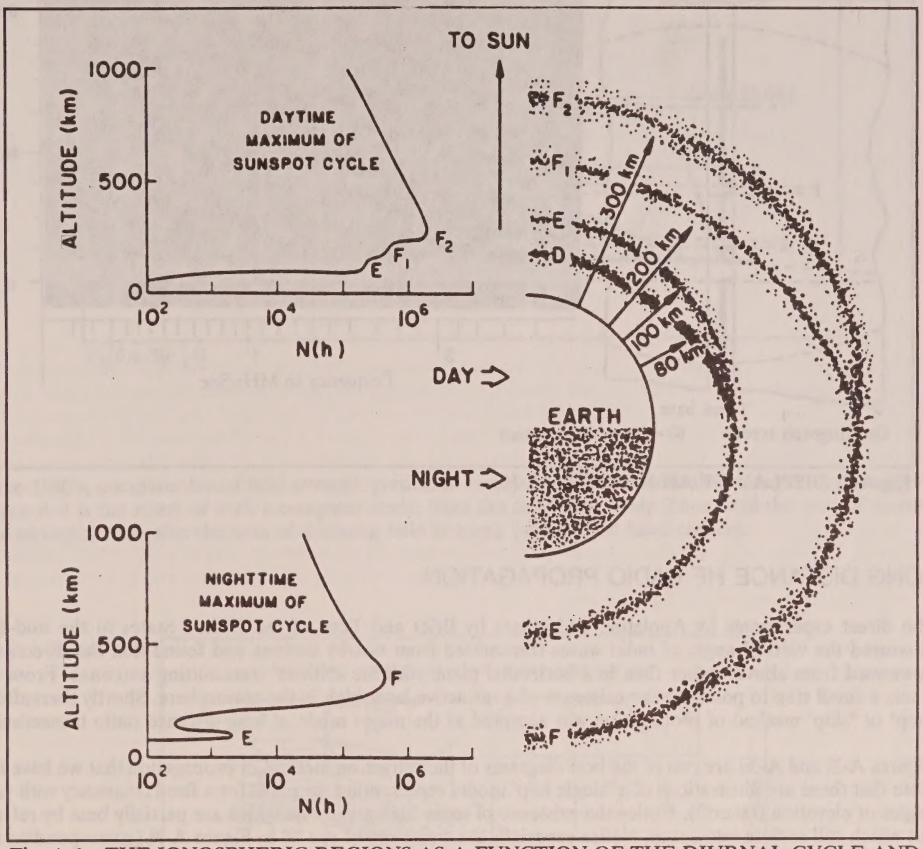

Fig. A-1: THE IONOSPHERIC REGIONS AS A FUNCTION OF THE DIURNAL CYCLE AND HEIGHT ABOVE THE EARTH'S SURFACE [2]

INVESTIGATIVE INSTRUMENTS AND TECHNIQUES: THE IONOGRAM

An understanding of the variability of the physical structure of the ionospheric layers is essential to any discussion about HF propagation. The most important characteristics of the layers are their critical frequencies and virtual heights. Pulse-sounding equipment is commonly used to measure the effective height of the ionospheric layer(s) which is capable of "reflecting" vertically polarized RF radiation at various frequencies. The critical frequency is the highest frequency "reflected" by the ionosphere. This frequency can be converted to values which relate to the electron content of the ionosphere and the height of the "reflecting" layers. A device called an Ionosonde is used record these altitude-frequency characteristics of the ionosphere in the form of a photograph known as an Ionogram.

It is useful to imagine an ionogram as a photograph of a vertically oriented HF radar screen. The white lines represent the areas which are "returning" refracted signals to a ground station receiver. It is clearly possible to see the refractive regions and to relate height (vertical scale) to frequency (horizontal scale).

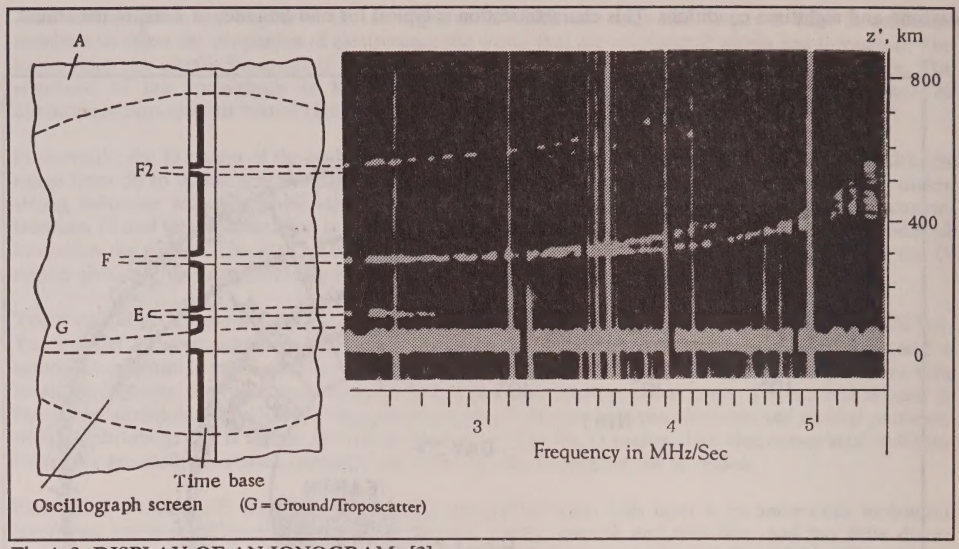

Fig A-2: DISPLAY OF AN IONOGRAM [3]

LONG DISTANCE HF RADIO PROPAGATION

The direct experiments by Appleton, and others by Briet and Tuve of the United States in the mid-1920's, measured the vertical angle of radio waves transmitted from nearby stations and found that the direction was downward from above, rather than in a horizontal plane with the stations' transmitting antennae. From there, it was a small step to postulate the existence of a refractive layer high in the atmosphere. Shortly thereafter, the "hop" or "skip" method of propagation was accepted as the major mode of long distance radio transmission.

Figures A-3i and A-3ii are two of the best diagrams of the refraction method of propagation that we have found. Note that these are illustrations of a "single hop" model representing ray paths for a fixed frequency with varying angles of elevation (takeoff). Notice the existence of some high-angle rays which are partially bent by refraction but which still radiate into space. Notice especially the trajectory of ray "9" in Figure A-3i (corresponding to ray "5" in Figure A-3ii) - it will be discussed in a later Section.

SINGLE HOP MODELS OF TRAJECTORY OF RAYS OF A SHORTWAVE SIGNAL

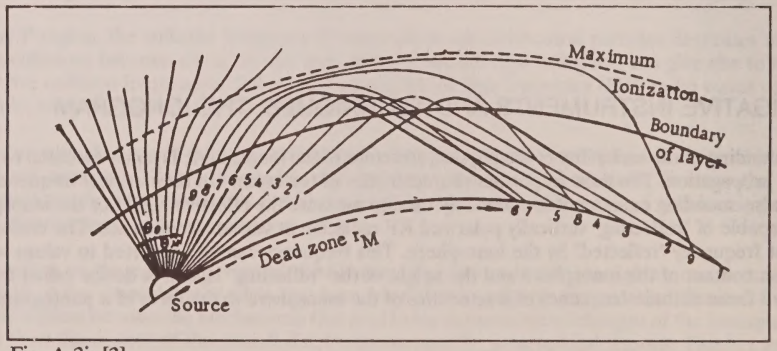

Fig. A-3i: [3]

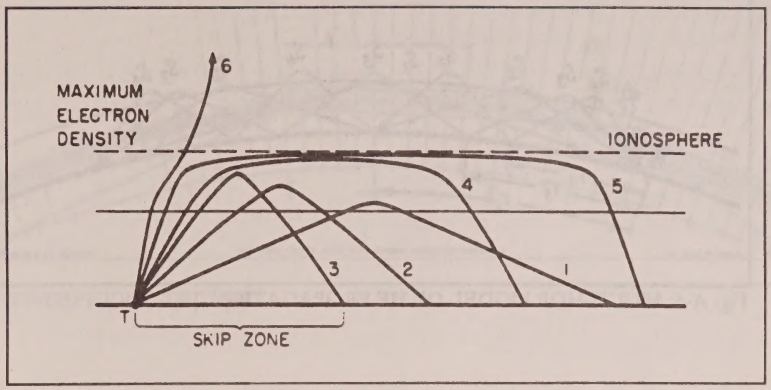

Fig. A-3ii: [4]

In the 1980's, computer-based field strength prediction models were quite accurate for single hop propagation. Figure A-4 is the result of such a computer study. Note the dead zone (Skip Zone) and the area of maximum field strength. Note also the area of declining field strength (upper right hand corner).

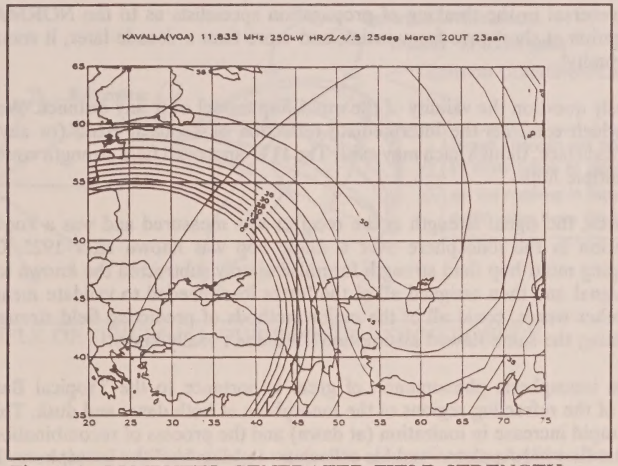

Fig. A-4: COMPUTER-GENERATED FIELD STRENGTH MODEL [1]

Early propagational authorities realized that the geometry of signal propagation by a single hop from a region just several hundred kilometers overhead could not explain communication paths which were already in daily use over transatlantic distances. These pioneer researchers postulated the now-familiar "multi-hop" model as the NORMAL means of long distance HF radio propagation. This model (Figure A-5) has been accepted by virtually all authorities for over fifty years.

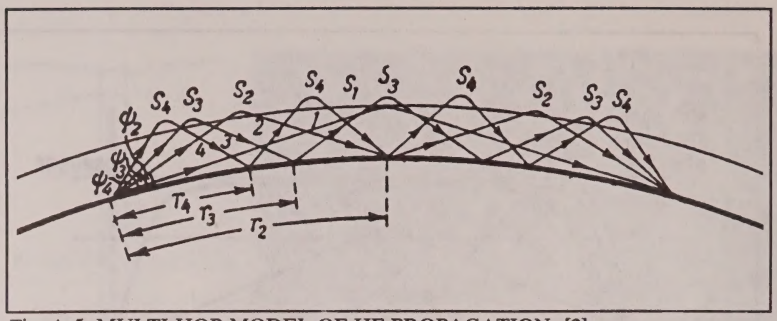

Fig. A-5: MULTI-HOP MODEL OF HF PROPAGATION [3]

But in the early 1970's, some members of the amateur radio community and some professional propagationists began to seriously question the multi-hop model, at least as it applied to "long haul" distances. In 1977, German authorities published the results of a decade-long study of the field strength of Deutsche Welle transmissions from Germany to Australia. The International Telecommunication Union/International Radio Consultive Committee (ITU/CCIR) field strength predictions of the day (based on a CCIR formula established in 1970) were shown to be understated by about 25 dB (that's 4 S-units!). [5]

The following year, the relevant committee of the CCIR developed a second prediction formula based on antipodal focusing gain and ionospheric propagation over long distances WITHOUT INTERMEDIATE GROUND REFLECTIONS. [6] That formulation is now the standard for predicting field strengths at transmission distances beyond 10,000 km.

This is a startling reversal in the thinking of propagation specialists as to the NORMAL mode of long haul ionospheric propagation at shortwave frequencies, and more than a decade later, it remains virtually unknown in the hobby community!

The authors seriously question the validity of the multi-hop model over any distance. We have not found ANY primary research which confirms the intermediate reflection of Tropical Band (or any other HF frequency) signals at the earth's surface, though such may exist. The ITU-approved field strength computations out to 10,000 km still assume multiple hops.

In early field research, the signal strength at the receiver was measured and was a known factor. The normal amount of attenuation in the ionosphere over a single hop was known after 1925. Could it be that early researchers developing multi-hop field strength formulae simply subtracted the known ionospheric attenuation from the original signal and then assigned all of the "extra loss" needed to validate measured field strength to "ground loss"? In other words, could all of the major methods of predicting field strength beyond 2,000 miles simply be reconfirming the same flawed assumption? We don't really know!

Another large-scale ionospheric phenomenon of great importance to the Tropical Band DXer is the rapid vertical movement of the refracting regions of the ionosphere at both dawn and dusk. This movement is in part attributable to the rapid increase in ionization (at dawn) and the process of recombination (at dusk). It was this rapid movement that first led Appleton and his colleagues to "discover" the ionosphere. The movement creates a band of "tilted" refracting layers which is about 500 km (330 miles) wide.

This "tilt zone" is thought to be responsible for both true grayline enhancement and for the four more common modes of "twilight enhancement" experienced as the zone passes above either the transmitter or the receiver twice daily. The geophysical mechanics associated with reception over these "partial darkness" paths will be addressed in Section B. Ionospheric tilts are also believed to be a complementary factor associated with "spherical convergence" (ray focusing) which will be discussed as we conclude this Section.

Figure A-6 is an excellent example of the tilt zone (on a north-south path crossing the Equator) at the terminator. The exact physics of tilt-zone enhanced propagation (which seems most dramatic at, but is not necessarily confined to Tropical Band frequencies) is not known with any precision at this time.

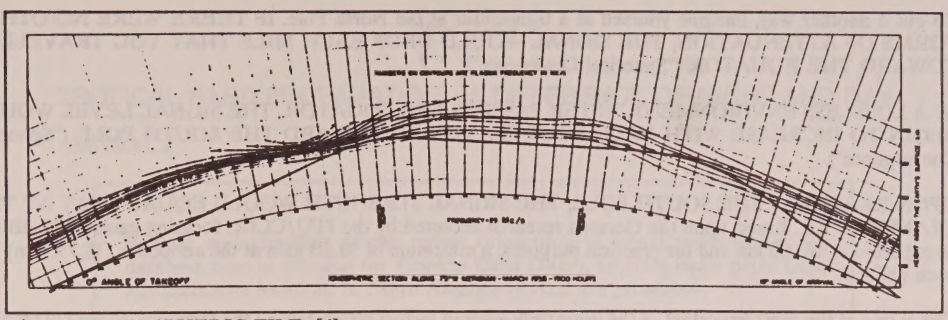

Fig. A-6: IONOSPHERIC TILT [4]

Finally, one other major inter-relationship between the planet and the ionosphere is of special interest to the Tropical Band DXer: Spherical Divergence and Convergence (also known as ray defocusing and focusing, respectively).

We have always assumed that the farther from the transmitter a signal reaches, the weaker the signal will be due to absorption losses associated with multi-hop refraction and reflection. Although radio is propagated as waves, the dispersion of the signal is often represented as radial rays. Assume an omni-directional vertical antenna and the diagram always looks as in Figure A-7 (left-hand drawing):

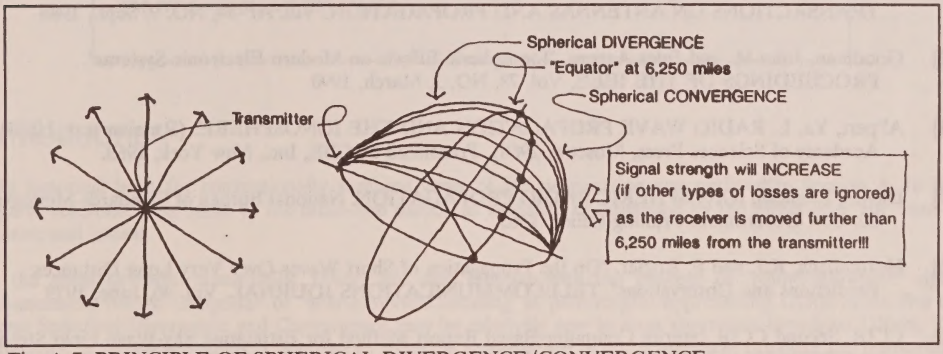
Spherical DIVERGENCE
"Equator" at 6,250 miles
Spherical CONVERGENCE
Transmitter
Signal strength will INCREASE
(if other types of losses are ignored)
as the receiver is moved further than
6,250 miles from the transmitter!!!

Fig. A-7: PRINCIPLE OF SPHERICAL DIVERGENCE/CONVERGENCE

The rays actually represent the wave. Field strength or density at any distance out from the transmitter is directly proportional to the distance between the rays. What we, and even the ITU, forgot or ignored until recently was that Figure A-7 (right-hand drawing) is a "floor plan" drawing, looking straight down on the centre of a spherical surface. Each of those rays is actually a Great Circle seen edge-on. If the rays originating at the transmitter are followed clear around the earth, it can be seen that they will converge on a spot on the exact opposite side of the planet. This is known as "antipodal focusing".

The rays do not travel in a straight line. They and the waves that they represent are travelling in a relatively narrow spherical void between two spherically curved surfaces. Further, since field strength is proportional to the distance between the rays, once the rays travel beyond the 6250 mile distant "equator", the field strength will INCREASE with distance (if other attenuating factors are ignored).

To put it another way, imagine yourself at a transmitter at the North Pole. IF THERE WERE NO OTHER FORMS OF ATTENUATION, THE SIGNAL WOULD DROP EACH MILE THAT YOU TRAVELLED TOWARD THE EQUATOR ("Spherical Divergence").

IN A LOSSLESS ENVIRONMENT, AFTER PASSING THE EQUATOR, THE SIGNAL LEVEL WOULD BEGIN TO INCREASE WITH EACH MILE TRAVELLED TOWARD THE SOUTH POLE ("Spherical Convergence").

UPON REACHING THE SOUTH POLE, THE SIGNAL STRENGTH WOULD EQUAL THAT AT THE TRANSMITTER. Based upon the German research accepted by the ITU/CCIR, focusing gains of 12 dB can be expected at 16,000 km and for practical purposes, a maximum of 30 dB gain at the antipodes (18,750 km) has been defined.

This is one of the most important of the previously ignored factors which caused the formulae of the ITU/CCIR to be incorrect or understated by as much as 25 dB. It was, and is, an easy error for any of us to make because it seems totally wrong-headed to conceive that field strength INCREASES with distance!

Taken as a whole, the current understanding of the large-scale elements of the ionosphere, its refractive regions and their interaction with each other, with the sun, and with electromagnetic waves, seems reasonable. With the exception of the recently recognized spherical divergence/convergence principle, the foregoing model is the foundation upon which the conventional view of HF radio propagation is built.

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[5] Hortenbach, K.J. and F. Rogler. "On the Propagation of Short Waves Over Very Long Distances: Predictions and Observations". TELECOMMUNICATIONS JOURNAL, Vol. 46, June, 1979

[6] CCIR. Second CCIR Interim Computer-Based Report Method for Estimating Sky-Wave Field Strength and Transmission Loss at Frequencies Between The Limits of 2 and 30 MHz (Supplement to Report 252-2); Kyoto, 1978. International Telecommunication Union. Geneva, Switzerland.

TROPICAL BAND PROPAGATION - A DIFFERENCE OF NIGHT AND DAY

ABSTRACT

A clear understanding of the typical orientation of signal paths within the darkness zone is essential for Tropical Band DXers, so great circle paths from representative locations in North America to Asia are presented.

Particular attention is accorded to the five possible partial darkness propagation situations generally recognized as being responsible for signal enhancement, with examples appropriate to North American DXers. The astronomical properties of the grayline zone are thoroughly discussed and signal behavior in this medium is distinguished from the dawn to dusk enhancements that occur at either the transmitter or the receiver.

The geophysical phenomena associated with the refraction process during twilight periods, including ionospheric tilts and signal ducting, are discussed. The classical view of dawn enhancement in terms of the multi-hop model is found to be wanting.

The authors postulate that predictable but heretofore unexplained seasonality patterns experienced by Tropical Band DXers in North America may be associated principally with ionospheric phenomena taking place in the region of the transmitter, not the receiver.

INTRODUCTION

The historical basis for conventionally accepted views of HF propagation was outlined in Section A. In that regard, reference was made to the multi-hop model, as modified or enhanced by the effect of a "tilt" zone at sunrise and sunset.

In the amateur radio community, DXers are also familiar with the concept of "round-the-world" signal enhancement due to "antipodal" or "near-antipodal focusing" at path-lengths approaching 12,500 miles. But the terms Spherical Divergence and Convergence may be relatively new to most shortwave broadcast DXers. The difference in the two concepts is that due to spherical convergence in the hemisphere opposite the transmitter, signals tend to become stronger the further you travel from the transmitter (beyond 6,250 miles). This is not a phenomenon limited to the area at or near the antipodes! We suggest the reader keep this concept in mind, since as Tropical Band DXers, we are commonly interested in planetary distances of 6,250 miles and more (a minimum of three "hops" in conventional parlance).

Applying these geophysical criteria to Tropical Band propagation, this Section will focus on darkness signal paths: the "total darkness" path and more importantly, the "partial darkness" path, of which we shall find there are five distinct variations.

The purpose of this Section is to establish a better understanding (at least in terms of commonly accepted propagation models) of why certain preferred (partial darkness) paths contribute to enhanced reception of long distance Tropical Band DX.

In North America, signal enhancement is also frequently associated with distinct seasonal reception patterns. The discussion will serve to introduce the possibility of other criteria for seasonal signal enhancement which fall outside the boundaries of today's "conventional wisdom".

GREAT CIRCLE PATHS

Shortwave signals normally propagate between any two points on the earth's surface by following a great circle path. The shortest planetary distance between those two points is called the short path. Conversely, if a signal were to propagate from the transmitter in the opposite direction, it would follow the long path route to reach the receiver.

Sometimes, solar-terrestrial events and/or geophysical factors at work in the ionosphere may cause a shortwave signal to adopt a "path of least resistance" which is a non-great circle path. For example, "signal bending" is often associated with signals crossing over or near the polar caps (see 'DXing Asians on the Tropical Bands - The Auroral Factor' by David Clark in PROCEEDINGS 1989.
The authors wish to acknowledge the anomalous occurrence of these signal bending phenomena. However, they are not of primary concern for the purpose of this article.

The traditional North American DX season on the Tropical Band extends from approximately mid-September until mid-April. With rare exception, signals arrive at our receivers by travelling the short great circle route. This applies to Asian and South American signals which, for most of us, follow a north-south and south-north path respectively. As well, it applies to African and Pacific signals whose respective signal paths to North America are essentially east-west and west-east. Since the primary interest of the authors is associated with DXing Asian stations, we will frequently refer to our experience as the basis for illustration throughout the article.

Perusal of azimuthal equidistant projections for various locations confirms that for DXers in Eastern and Central parts of North America, the short great circle path for most Asian signals (except for Austral-Asia) falls within +/- 20-25 degrees of a north-south orientation. The opposite long path route (south-north) would intersect the southern polar zone during the hemispheric summer and thus would be subject to total D layer absorption, also known as "solar blanking" (see 'Terminator Mechanics and Trans-Polar Solar Blanking' by John Bryant in PROCEEDINGS 1988).

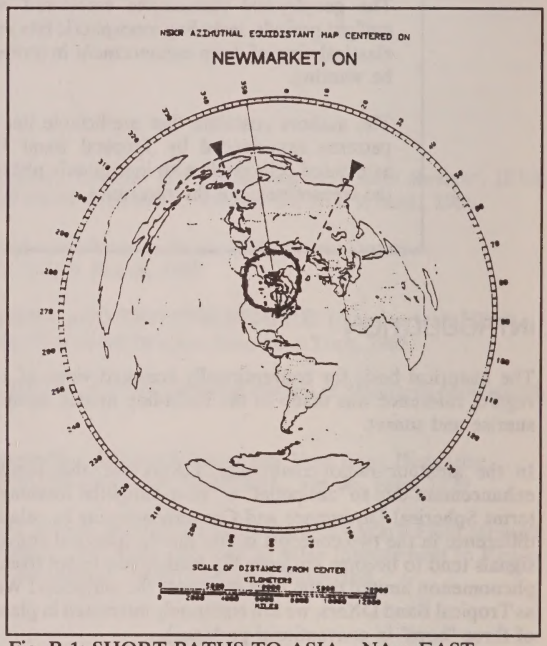

Fig. B-1: SHORT PATHS TO ASIA - NAm EAST

For DXers located near the West Coast of North America, the azimuth of Asian signals is somewhat different. Short path signals from South-Central Asia (ie. in the direction of the Indian Sub-continent) do follow a NW-SE path, but signals from Southeast Asia follow an essentially west-east route. Long path signals travelling in the opposite east-west direction would unavoidably intersect the daylight side of the earth and thus would be lost to 'D' layer absorption too.

To illustrate the short path for Southeast Asia, we've selected Banjarmasin, Kalimantan, because its position on the island of Borneo basically divides the breadth Southeast Asia in half. The considerable differences in orientation of the great circle route from eastern, central and western parts of North America are readily apparent by examining the broken lines in Figures B-1, B-2 and B-3. For South-Central Asia, the other broken line to Colombo, Sri Lanka, shows a wide swing in the heading of the short path, varying from NE to NW as you move from east to west across North America.

The solid line on each of these maps represents the great circle path from Asia towards North America which passes through the "donut-hole" in the centre of the polar cap (ie. intersecting the North Magnetic Pole). This reminds us that reception of signals from certain parts of Southeast or South-Central Asia is going to be influenced by the surrounding auroral zone and/or conditions within the polar cap itself.

Fig. B-2: SHORT PATHS TO ASIA - NAm CENTRAL

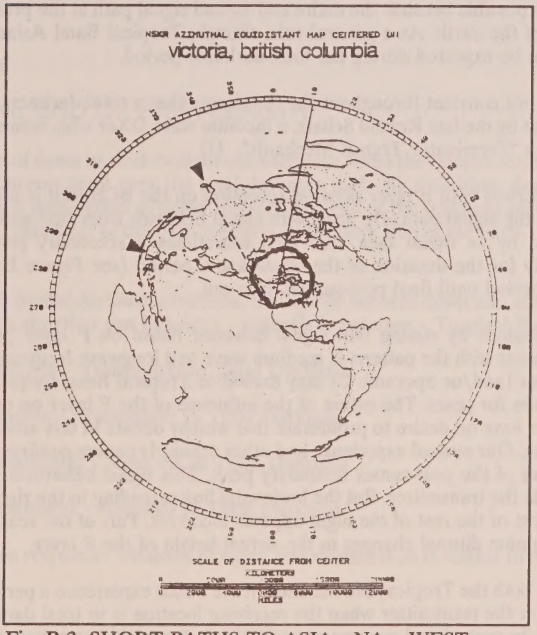

Fig. B-3: SHORT PATHS TO ASIA - NAm WEST

In general, a knowledge of great circle paths is important to Tropical Band DXers who must be concerned about where it's dark and where it's not. It is also useful for pointing directional antennas to achieve optimal weak signal pickup. Finally, it is critical to know if the heading of the signal is in the direction of the auroral zone.

FACTORS CONTRIBUTING TO ENHANCED PROPAGATION

The particular orientation of the short path for any signal originating in Asia is an important consideration to most Tropical Band DXers in North America for three reasons.

First, as noted above, signals intersecting the northern auroral absorption zone may be subject to anomalous enhancement as they travel through the polar "donut-hole" or are "bent" around the outer periphery of the auroral ring. Clark's article in PROCEEDINGS 1989 focusses specifically on signal enhancement related to solar flares and the onset of geomagnetic disturbances.

Secondly, for Asian signal paths whose arrival azimuth lies somewhere between NW and NE, it is appropriate to recognize that at certain times of the year, this great circle path will be a "true grayline" path. Signals travelling in a west-east orientation will not be enhanced as a direct result of this phenomenon.

Note that both of these signal-enhancing factors could be happening at the same time, thus having a mutually complementary effect. These criteria, taken separately or together, are the most likely explanation for unusually strong reception of Tropical Band Asians sometimes experienced by DXers in Eastern North America in late afternoon during the DX season.

Third, and most important to us in this article, is the enhanced propagation experienced by all DXers based on the incidence of dawn or dusk at ONE end of the signal path. Most DXers equate this with dawn enhancement at the receiver, although this is just one of four such possibilities. We will compare this carefully with the "true grayline" path.

DARKNESS PATH DEFINITIONS

I. Total Darkness Path:

Tropical Band reception is possible because the entire end-to-end signal path at the prescribed time is contained within the darkness side of the earth. As a general rule, though, Tropical Band Asian signals do not seem to propagate as well as might be expected during the total darkness period.

Note that signal levels do not constant throughout the timeframe that a total darkness path exists between two points. This was pointed out by the late Ronald Schatz, a medium wave DXer who, some ten years ago, published several papers dealing with "Terminator Transit Mechanix". [1]

Basically, Schatz was concerned with E layer skywave reception on the BCB as it is affected by the occurrence of sunset or sunrise along the signal path. He dealt with signal behavior from first audio at sunset fade-up, the post-sunset peak followed by an initial fade, and then sometimes a secondary peak before a signal level subsequently settled evenly for the duration of the all-darkness period (see Figure B-4). The converse would occur during the sunrise period until final post-sunrise fade-out.

Schatz qualified his conclusions by stating that signal behavior based on F layer propagation at shortwave frequencies was not consistent with the pattern at medium wave and longwave frequencies. The extent to which the influence of the E layer (and/or Sporadic E) may extend to Tropical Band frequencies has been a contentious issue for years. The extent of the influence of the F layer on upper BCB signals is also controversial. The authors have no desire to proliferate that worthy debate in this article. Nonetheless, Schatz's observations are interesting. Our mutual experience and other scholarly papers confirm the pattern shown in the illustration, up to the point of the post-sunset secondary peak. This signal behaviour pattern inherently starts with sunset enhancement at the transmitter. But the horizontal line extending to the right and indicating a steady signal level throughout most of the rest of the night appears incorrect. Part of the reason for this will be found in Section D when we examine diurnal changes in the virtual height of the F layer.

DXers of Asian signals on both the Tropical and Medium Wave bands experience a period a signal enhancement with the arrival of sunset at the transmitter when the receiving location is in total darkness. This phenomenon is usually more noticeable in central and western parts of North America, but enhancement of signals at dusk, Pacific time, can be experienced also in the East with surprisingly good signals at times. Typical examples are the fade-up of Solomons on 5020 kHz around 0730, sometimes followed by the numerous Papua New Guinea stations at +/-0830.

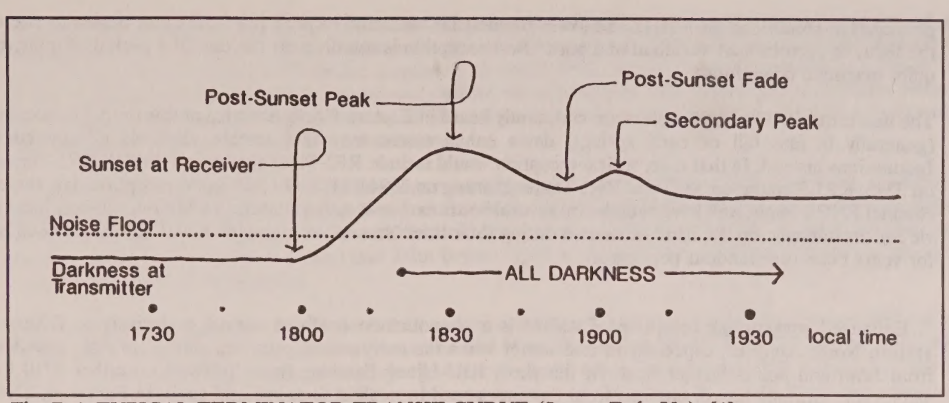

Fig. B-4: TYPICAL TERMINATOR TRANSIT CURVE (Sunset Fade-Up) [1]

On the West Coast, a second post-sunset peak may be observed (about 9 PM local time at the transmitter). Thereafter, for the duration of the all-darkness period, the signals will typically fade down severely, if not disappear altogether as the path appears to "wear out". They will re-appear at commencement of the familiar dawn peak in North America.

We will revisit this very interesting second peak later in the article. Note, however, that it is seldom distinguishable to DXers in the East because 9 PM at the transmitter often corresponds with the period of sunrise enhancement at the receiver.

II. Partial Darkness Paths:

(a) TWILIGHT AT ONE END OF PATH-LENGTH

This is the classic situation of dawn or dusk twilight enhancement when the relative strength of the Tropical Band signals shows a marked improvement over the total darkness path. By definition, dawn or dusk enhancement relating to a partial darkness path occurs at either the receiving end or the transmitting end of the path, but NOT both. In all such cases the remainder of the path-length is on the dark side of the earth. Note the distinction from a "true" grayline path.

Clearly there are four such partial darkness situations, taking into account dawn and dusk twilight at the receiver, or at the transmitter. Each situation can influence - potentially enhance - Tropical Band reception. They are:

1. Sunrise at the Receiver - Transmitter in Total Darkness
2. Sunset at the Receiver - Transmitter in Total Darkness
3. Sunrise at the Transmitter - Receiver in Total Darkness
4. Sunset at the Transmitter - Receiver in Total Darkness

Let's examine each of these respective windows of signal enhancement as it relates to North American Tropical Band DXers:

TWILIGHT AT THE RECEIVER

1. The enhanced sunrise-dawn period of reception is familiar to most DXers. It can be experienced with respect to Asian signals by DXers situated throughout North America. Some would say dawn enhancement is the most pronounced. In his 'Propagation' column in CQ Magazine, George Jacobs consistently says that

propagation conditions on 7 MHz and lower frequencies "will tend to peak just as the sun begins to rise on the light, or easternmost, terminal of a path." Best reception is usually near the end of a period of relatively quiet magnetic conditions.

The numerous PNG's on 90 meters are commonly heard in Eastern North America at this time. On occasion (generally in late fall or early spring), dawn enhancement may find certain channels dominated by Indonesians instead. In that case, typical reception would include RRI-Palangkaraya on 3324.9, RRI-Ternate on 3345, RRI-Kupang on 3385 and RRI-Tanjungkarang on 3394.9 kHz. On that same reception day, the co-channel PNG's might well have been heard several hours earlier at Asian sunset. In addition, sub-continentals vie for prominence on the band at sunrise during their brief "season" in mid-winter. AIR-Delhi on 4860 has for years been the standout performer.

2. Enhanced sunset-dusk reception of Asians is a phenomenon confined almost exclusively to DXers in eastern North America, especially in mid-winter when the early sunset precedes sunrise in Asia anywhere from Jawa and points further west. At this time, RRI-Ujung Pandang from Sulawesi on either 4719.3 or 4853.3 is commonly heard. Stations from Sumatera tend to peak in October and again in February. These trans-polar openings are invariably most pronounced at the commencement of a magnetic disturbance and more-so at sunset than at sunrise.

West and Central African signals are sometimes heard well at local dusk in mid-winter by DXers in Central North America and even on the West Coast, better than several hours later when the Africans commence their morning broadcasts. DXers in the East will often find these signals rising to good strength an hour or more before dusk throughout the DX season.

TWILIGHT AT THE TRANSMITTER

3. Asian sunrise-dawn signal launch enhancement is again most noticeable during mid-winter in Eastern North America when evening darkness is already established prior to sunrise at Sumatera and points further west. On occasion, reception of Sumatrans may extend to Central North America at mid-winter. As in (1) above, the trans-polar signals are frequently enhanced with the onset of a magnetic disturbance.

Sunrise at the transmitter is the alternative time for North American DXers to log East Africans (0300+), Central and West Africans (0400+) and South Americans (0800+) - beginning with Eastern Brazil.

4. Asian sunset-dusk signal launch enhancement is rarely as pronounced in Eastern North America as the sunrise period of reception enhancement which follows several hours later. One example, however, is the brief appearance of stations from Jawa at local dusk around 1130, some two hours before dawn in the eastern time-zone at mid-winter. The sunset enhancement of Asian signals is dramatically more pronounced in central and western regions of the continent. Normally, a quiet geomagnetic field would be preferred.

Throughout much of North America, dusk at the transmitter is an ideal time to log Latin signals, especially from Bolivia and Peru. Note that in the eastern time-zone, this peak occurs in the hour or so after darkness has set in at the receiver. While reception might normally be best during relatively quiet conditions, trans-equatorial routes are at times, apparently enhanced in the early stages of a disturbance.

West Coast DXers often find their best reception of Pacific stations to be the thirty or forty minute period of enhancement commencing with sunset at the transmitter. For example, the only reliable time to hear Radio Northern (PNG) on 3345 kHz is to "DX sunset at the transmitter". Many mornings, it is possible to hear Radio Northern fade up to good reception levels around its local sunset. After nearly an hour of decent reception, the PNG fades down and the co-channel Indonesian powerhouse, RRI-Ternate arrives to dominate the frequency.

To conclude this discussion of partial darkness paths associated with twilight at one end of the path-length, we would like to relate a personal experience. In March, 1990, the authors met for a four-day DXpedition at Grayland, WA, camping out in a state park fronting onto the open Pacific. As it turned out, conditions were especially good for reception of Medium Wave, as well as Tropical Band signals from the South Pacific and into East and Southeast Asia.

The morning of March 19th provided an outstanding example of DXing the sunset enhancement period at the transmitter. We had prepared for this opportunity by running a computer listing of sunset times for virtually every broadcast site from Hawaii to Thailand. Beginning at about 0600, we were able to tune-in to a given Pacific Island medium wave channel about ten minutes before the appropriate sunset time and wait. More often than not, the desired signal would rapidly fade up off the receiver noise floor precisely at the station's sunset and then hold at astonishingly good levels for some time.

For the next several hours, we DXed the western sunset, logging most of the Pacific Islands on medium wave in the process! Even two PNG medium wave outlets were logged, parallel their respective 90 meter channels. Most of the 90 meter Papuans were at "armchair" S9+ levels at 0830 on this morning. Reception was so exceptional (even for the West Coast) that John Bryant taped a one-half hour bandscan which was later sent to Gordon Darling in Port Moresby.

As the night progressed, several 120 meter Indonesians were heard, as well as the rarely reported RRI-Merauke on 3904.9. 'Down-Under' loggings from Australia and New Zealand on medium wave were too numerous to mention. It was an exciting night as we rode the wave of sunset enhancement across the Pacific. Of course, we readily acknowledge that a choice of 2000 foot beverages pointed west and southwest (terminated a few hundred feet from the shoreline) contributed to our success!

(b) GRAYLINE - TWILIGHT ALONG ENTIRE PATH-LENGTH

Propagation along grayline paths seems to be enhanced by more efficient signal refraction and "ducting" phenomena. This often results in signal levels reaching their optimal potential; at least that is the generally accepted understanding.

A "true grayline" path occurs when both the transmitting location and the receiving location are in a period of dawn or dusk twilight. Provided the signal adheres to the great circle path, the entire path-length and shortest distance from transmitter to receiver will be along the narrow zone of twilight dividing the darkness and daylight sides of the earth. This dividing line between darkness and daylight is also called the "terminator".

All true grayline paths to and from North America vary between NW-SE and NE-SW, depending on the season and whether dawn or dusk at the receiver in North America. At the Equinox, when the dividing line between darkness and light lies along a true north-south axis, it is sometimes possible to hear the same station, initially at the morning grayline and later the same day, at the dusk grayline. The seasonal positioning of the grayline is shown in Figure B-5.

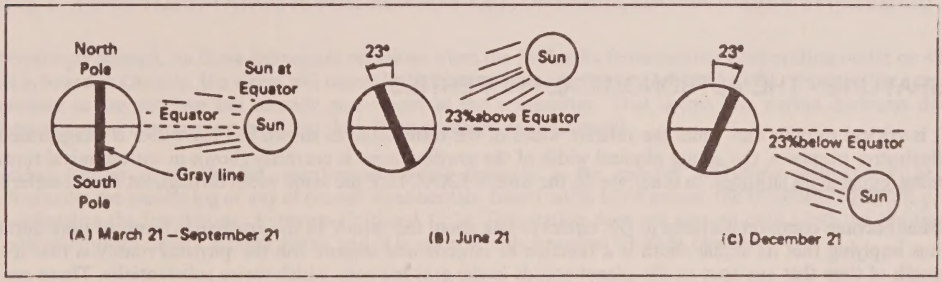

Fig. B-5: SEASONAL ORIENTATION OF THE GRAYLINE [2]

Assuming we are facing the western hemisphere in the above illustration, the grayline orientation at the summer and winter solstices would be representative of the dawn grayline at our receivers. At dusk, the corresponding angle from True North would be reversed.

In the western hemisphere, grayline reception from Latin America is always based on dawn (or dusk) twilight along the entire signal path. However, since Asia is in the opposite hemisphere, Asian twilight at dusk will correspond with dawn twilight in North America and vice versa.

Recently available computer software provides an ideal way of visualizing the grayline separating the sunlit and darkness sides of the earth and actually observing the east to west movement of the grayline in "real time". The azimuthal equidistant map can be customized so that it is centred on the location of the DXer's receiver. The short and long path from the receiver to a specified transmitter target is also displayed.

Fig. B-6: COMPUTER-GENERATED GRAPHICAL DISPLAY OF DUSK GRAYLINE [3] (April 29 UTC at Frederick, Maryland)

GRAYLINE - THE ASTRONOMICAL PROPERTIES

It is critical to note that while the relative width of the terminator as shown in Figure B-5 is exaggerated for illustrative purposes, the actual physical width of the grayline zone is correctly shown in astronomical terms as being equal at all latitudes. In other words, the zone is EXACTLY the same width throughout its circumference.

It has become common parlance in DX circles to talk about the "width" of the grayline in terms of time duration, thus implying that its actual width is a function of latitude and season. But the physical reality is that it's the length of time that any spot on the planet spends in the grayline zone which varies substantially. There are two reasons for this.

First, the absolute speed of rotation of any spot on earth varies a great deal: very fast at the equator but very slow approaching the polar caps. Any spot on the Equator for instance is in the grayline zone for only a short period of time, varying only by a few minutes throughout the year, while a similar spot within the Arctic Circle will spend much longer moving through the same width grayline zone.

Secondly, the zone of twilight is inclined at various angles related to the seasons. Again, the length of time varies, in this case according to the diagonal path at which the zone is passing over any spot. Thus we could say the apparent (or visual) width of the grayline varies but the real width is constant!

Given this understanding, the DXer is better-equipped to evaluate the duration of a grayline condition for a given signal path. The entire signal path along the terminator must be considered. For example, most signals from Southeast Asia originate within the Equatorial Zone - Indonesia itself straddles the Equator. Thus, even at mid-winter when the grayline "width" at the receiver may be more than hour in many parts of North America, the effective width of the grayline zone, where the transmitter is located in the Equatorial Zone, is not more than twenty minutes.

Figure B-7 is a partial listing of grayline targets at Clark's QTH (Newmarket, Ontario) for December 31st, generated using John Devoldere's 'Low-Band DXing' software. [4] This happens to be about the mid-point of the six-week annual period when the sub-continentals are "in season". Notice that the grayline "width" is +/- 38 minutes of 12:54 Newmarket sunrise, whereas the "width" at Colombo, Sri Lanka is only +/- 10 minutes of 12:35 sunset. Thus, the time when the grayline zone is in place along this entire path-length is limited to the brief period of "overlapping" twilight from 12:25 to 12:45.

YOUR LATITUDE IS 44.5 DEG. NORTH YOUR LONGITUDE IS 79.47 DEG. WEST
TIME OF YEAR (MONTH/DAY) = 12 / 31
YOUR SUNRISE IS AT 12.54 UTC YOUR SUNSET IS AT 21.47 UTC
GRAY LINE WIDTH IS 76 MINUTES. MINIMUM TARGET DISTANCE IS 7000 MILES

PREFIX	COUNTRY	CITY	MILES	START	END	MIN/TARG
4S	SRI LANKA	COLOMBO	8653	12.25	12.45	20
8Q	MALDIVE	MALE	8677	12.55	13.15	20
9M6	EAST MALAYSIA	KOTA KINABALU	8753	22.07	22.25	20
A4	OMAN	MUSCAT	7033	13.12	13.32	34
BV	TAIWAN	TAIPEI	7448	22.21	22.25	36
DU	PHILIPPINES	MANILA	8151	22.08	22.25	25
KC6	REP.OF BELAU	YAP	8026	21.09	21.14	21
VK6	AUSTRALIA	PERTH	11233	21.09	21.23	20
VS5	BRUNEI		8902	22.18	22.25	20
VU	INDIA	BOMBAY	7713	12.27	12.57	29
VU	INDIA	NEW DELHI	7173	12.16	12.24	40
VU	INDIA	BHOPAL	7514	12.16	12.31	34
VU	INDIA	ALIGARH	7232	12.16	12.23	39
VU	INDIA	MADRAS	8257	12.16	12.35	24
VU7	LACCADIVE ISL.		8292	12.46	13.08	21
YE	INDONESIA-JAWA	CIREBON	9777	22.23	22.25	20
YE	INDONESIA-JAWA	PURWOKERTO	9817	22.19	22.25	20
YE	INDONESIA-JAWA	YOGYAKARTA	9828	22.14	22.25	20
YE	INDONESIA-JAWA	SEMARANG	9771	22.15	22.25	20
YE	INDONESIA-JAWA	SURAKARTA	9806	22.13	22.25	20

Fig. B-7: GRAYLINE TARGETS FOR NEWMARKET, ONTARIO, ON DECEMBER 31 (partial list)

Interestingly enough, on those infrequent occasions when the Sri Lanka Broadcasting Corporation outlet on 4902 kHz is heard in Ontario, the signal will normally fade up and peak between 12:45 and 13:00 - crossing the sunrise boundary at the receiver but already post-sunset at the transmitter. That seems like partial darkness dawn enhancement at the receiver, more-so than "true grayline" enhancement!

Looking further down the list, another interesting example is the case of AIR-New Delhi (4860 kHz), undoubtedly the easiest log of any of the sub-continentals. Based on its 12:04 sunset, the theoretical grayline peak is confined to the few minutes between 12:16 and 12:24. This station does not sign on until 12:45 but the signal consistently peaks later - around 13:00, and it is often readily heard to 13:30 in Ontario.

By way of comparison, at Bryant's QTH in Stillwater, Oklahoma, sunrise does not take place on December 31st until 13:43 which results in a calculated grayline "width" of +/- 28 minutes. Both Asian sites are clearly in total darkness for more than an hour before sunrise at the receiver. The fact is, however, Bryant enjoys very good reception approaching sunrise and until 14:30 or later. There can be no confusion about this. Optimum reception has occurred in association with dawn enhancement at the receiver.

There are three points to be made here. First, the period of signal enhancement attributable to the grayline may not be of the duration implied at the receiver - the entire path-length along the terminator must be considered. Secondly, peak reception in many cases may not co-incide with the grayline duration per se. To the extent that we may enjoy extended "max dawn" enhancement of Asians (post-sunset at the transmitter) during the winter months, this ought to be understood as enhanced reception based on a partial darkness path but not a "true

grayline" path. Finally, one must remain aware of the seasonal aspect. We hear the sub-continentals at December 31st because they happen to be at their seasonal peak.

We have stated that any path associated with grayline enhancement (to the extent such exists) must follow the terminator. This brings up the point that the mechanics of grayline propagation within (along) the terminator has not been satisfactorily explained in any of the professional work that our research has covered. In the absence of any adequate explanation, we would concur with this statement by John Devoldere in Low-Band DXing:

> "It is not clear whether propagation proper inside the grayline along the terminator benefits from its existence. It is clear, however, that signal launching at the transmit end and receive end does benefit greatly from the mechanism". [5]

A little confusing perhaps? Small wonder even the "experts" tend to use terms such as dawn or dusk enhancement and grayline enhancement interchangeably. We again quote Mr. Devoldere:

> "Some authors have mentioned that grayline propagation always happens along the terminator. On the low bands [meaning the 120, 80 and 40 meter amateur bands] there has been occasional proof of such propagation although most of the grayline situation benefits have been noticed on paths typically perpendicular to the terminator." [5]

Surely the author is referring to partial darkness paths with dawn or dusk twilight at one end of the path or the other. In that case we would agree. But to associate "grayline benefits" with paths "perpendicular to the terminator" is a contradiction in terms!

The authors regard the distinction to be significant. Our experience as cited in the foregoing examples, and that of others, is that optimal reception is most often associated with a partial darkness path wherein the twilight condition is present at just one end of the path, not wholly along (within) the terminator!

Most important of all for us in this article, enhanced reception implied by a grayline path often does not "hold up" when the seasonal factor is taken into account. For example, many DXers were pleased to hear Bhutan as a new country in January of 1990 when the word spread that they had switched from the 49 meter band to 5023.1 kHz in the 60 meter band. That was the time to hear it because stations near the Indian Sub-continent were still "in season". By the end of the month, Radio Bhutan had virtually disappeared, at least in Ontario.

As winter turns to spring, there is a "perfect grayline" path from Bhutan to Oklahoma on April 1st (see Figure B-8) when sunrise at Bryant's QTH and sunset at the transmitter co-incide to the minute! It would be wrong to say that it's impossible to hear Radio Bhutan in April, as "true graylining" does work some percentage of the time. Even so, the chances of hearing a good signal are minimal because the season just isn't right.

	13.43	23.24	JAN 1	00.52	11.18	
	13.42	23.37	JAN 15	00.53	11.28	BHUTAN
OWN QTH	13.33	23.54	FEB 1	00.49	11.41	THIMPU
-------	13.19	00.1	FEB 15	00.39	11.52	----------
LONG = 97.5	13.02	00.23	MAR 1	00.27	12.01	LONG = -89.65
LAT. = 36.83	12.41	00.37	MAR 15	00.12	12.09	LAT. = 27.53
	12.18	00.51	APR 1	23.54	12.18	
==========>>>	11.56	01.04	APR 15	23.38	12.26	<<<==========
	11.37	01.17	MAY 1	23.24	12.34	
	11.22	01.30	MAY 15	23.13	12.43	
	11.13	01.43	JUN 1	23.06	12.51	
	11.10	01.51	JUN 15	23.06	12.58	
UTC TIMES	11.14	01.53	JUL 1	23.09	13.01	

Fig. B-8: COMPARATIVE SUNRISE/SUNSET TIMES AT STILLWATER, OKLAHOMA AND THIMPU, BHUTAN (partial list)

Earlier in this Section we referred to a "second peak" occurring about 9 PM at the transmitter (ie. about three hours behind the dusk terminator). In many cases for Asian signals, this will correspond with dawn at the receiver in North America, especially in the Eastern and Central time-zones. Now refer again to Figure B-8. As compared with the "true grayline" on April 1st, notice that on January 1st, sunset in Bhutan precedes sunrise at Stillwater by some two and one-half hours. In this case at least, the maximum signal (seasonal peak) from Bhutan occurs after the terminator has already passed over the transmitter several hours previous, whereas it is dawn at the receiver.

It took us a while to notice this relationship but when we did, we rapidly concluded this was a phenomenon that warranted further study. We shall return to the seasonality issue at the end of this Section and in following Sections.

TROPICAL BAND PROPAGATION MECHANICS - THE CONVENTIONAL VIEW

Accepting the conventional view of shortwave propagation as outlined in Section A, the signal path from anywhere in North America to a given location in Asia requires a minimum of four hops, assuming about 2,000 miles per hop based on night-time F layer propagation. This translates into signal losses associated with a minimum of four refraction points in the ionosphere and three intervening ground reflections. Let's think about that! To cite Yuri Blanarovich, whom we shall introduce in Section C, "considering the natural dispersion of the signal with distance and loss per [refraction] off the ionosphere and [reflection off] the earth, it seems to me that it is very unlikely that we could have any signal left at the other end". [6]

But, if there were some way in which the number of hops could be reduced, complemented by a decrease in the amount of absorption at each point of refraction/reflection, this could mean a useful increase in the strength of the signal by the time it reaches us. This is what seems to take place with partial darkness or twilight propagation, thus affording greatly improved reception.

Partial darkness at either end of the path offers significant advantages when compared to an all-darkness path, while twilight at both ends of a path is presumably more advantageous than twilight at only one end. Thus, "true grayline" is commonly considered to be the preferred path.

Let's consider four geophysical phenomena associated with twilight propagation. In each case, enhanced signal levels could occur due to less signal absorption resulting from the manner in which the signal is refracted and/or "ducted" in the ionosphere:

1. Less Absorption Due To Fewer Signal Hops:

During daylight hours, the D layer of the ionosphere is present and absorbs skywave signals at Tropical Band frequencies, thus making long distance reception impossible. Daytime MUF's often exceed 20 MHz.

At dusk, however, the D layer begins a period of rapid decomposition as a result of the process known as "recombination". Although it does not totally disappear until some hours after sunset, the D layer ceases to be a major propagational factor after dusk.

The reverse process occurs during the dawn period. As the sun rises above the horizon, the D layer begins to form, slowly at first, then rapidly until it reaches peak strength near local noon. Note than "sunrise" at ionospheric heights occurs some minutes before sunrise at ground level. The initial formation of a weakly ionized D layer at dawn again is advantageous. How is this so?

During these twilight periods, the D layer has ceased to be (or is not yet) strong enough to absorb the Tropical Band skywave signals. What it does is "deflect" or more precisely - refract, the skywave signal from the transmitter in a way that the angle at which it reaches the higher F layer (the "angle of incidence") is such that the wave is flattened out or lowered to some degree. The intervening E layer may play a complementary role in this process as well.

As a result of this change in the wave angle, the signal travels further in this modified trajectory before being refracted back to earth. The geometry of this event is clearly shown in Figure B-9, although the wave angles and height of the layers are very exaggerated in this sketch. Signal "B" is launched from a from a transmitter in the twilight zone at local dawn, whereas signal "A" is launched in total darkness.

In addition, the lower angle of arrival after refraction means the wave has travelled correspondingly farther before the initial reflective "bounce" on the earth's surface. This longer hop ultimately translates into fewer hops required to travel a given distance from transmitter to receiver, and thus, less absorption.

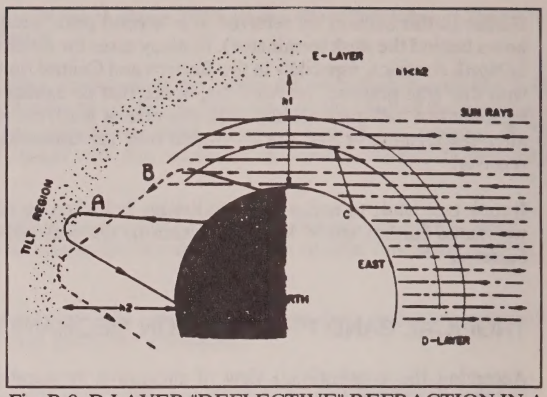

Fig. B-9: D LAYER "DEFLECTIVE" REFRACTION IN A TWILIGHT ZONE [4]

The effect of the "tilt region" shown in Figure B-9 will be discussed later. Notice also that the two-dimensional drawing, if taken literally, shows sunrise enhancement at the transmitter. A grayline path would require that the signal travel along the terminator (looking straight down the page). In a partial darkness situation where twilight is occurring at the receiver location instead, correspondingly enhanced refraction of the final hop would seem to account for the distinct dawn or dusk signal peak.

In a grayline situation, both signal launch at the transmitter and reception at the other end of the path are deemed to be beneficiaries of this twilight enhancement. What is not well understood is the propagational behavior along the terminator between the transmitter and the receiver. Here, one might speculate that the presence of a moderately ionized E layer along the path could be an important factor. We just don't know. But whatever the interaction between the signal and the ionospheric layers, if the signal leaving the transmitter remains focussed on the terminator it would be following the great circle or shortest path to the receiver. Sometimes, however, the signal may "veer" into the darkness zone along the way. Typical causes might be a differential MUF due to "patchy clouds" in the ionosphere or bending around the auroral zone. While this would result in a skewed path, the enhancement associated with twilight at both ends of the path might well still occur.

2. Less Absorption Due To More Efficient Refraction:

We have seen how refraction by "deflection" in the twilight D region reduces ultimate absorption because the number of signal hops to travel a given distance is reduced. A second beneficial effect deriving from D layer refraction at twilight serves to reduce absorption even more: an actual reduction in the amount of absorption at the time the F layer refraction process takes place.

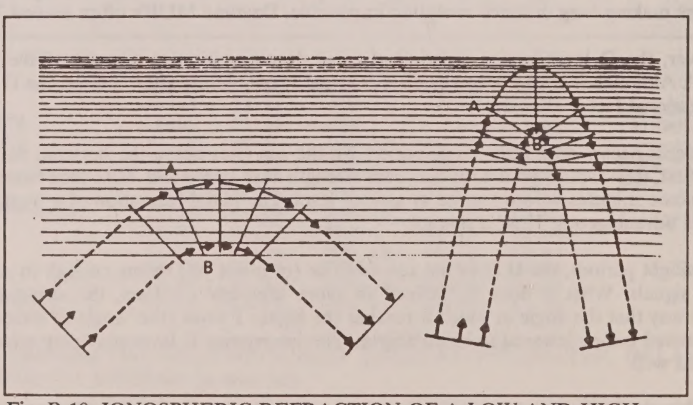

Fig. B-10: IONOSPHERIC REFRACTION OF A LOW AND HIGH ANGLE WAVE FRONT [7]

When a radio wave reaches the charged particles composing a refracting region of the ionosphere (for our purposes this is generally the F layer), it penetrates the refracting layer and is gradually bent back towards the earth. Refer to Figure B-10. A certain amount of energy is absorbed or lost during this "conduction" process due to the interaction with free electrons which are also present in the ionized region.

If the radio wave arrives at a high, almost vertical angle, it must penetrate the ionized region further before interacting with a sufficient concentration of charged particles to be refracted. This means a significant loss of energy.

On the other hand, a signal which reaches the ionosphere at a lower angle, such as we determined would occur during a twilight period, is more easily refracted with less penetration of the ionized region. The result of this more efficient refraction is, of course, appreciably less absorption. Amateur radio operators working DX try to take advantage of the same principle by using an antenna system that will provide a low "takeoff angle" from the transmitter.

3. Ionospheric Tilts:

Twilight signal enhancement has been described in terms of reduced absorption from two points of view: fewer hops and more efficient refraction, both deriving from the manner in which the weakly ionized D layer, and possibly the E layer, "deflects" the originating signal before it reaches the higher layers of the ionosphere.

Reference was made in Section A to the rapid vertical movement of the layers during the dawn and dusk period. This transitional process affecting the E and F layers is another regular occurrence in the ionosphere which is not sufficiently understood. However, the refracting layer(s) in the ionosphere are literally tilted at twilight, possibly producing even flatter wave-paths. This complementary effect would contribute to an even longer hop than would be defined solely by the process associated with the twilight D layer. In addition, it is noted that a tilt zone (at the receiver) may augment the increased signal strength naturally resulting from Spherical Convergence at distances beyond 6,250 miles.

So, while the process is not entirely understood, there is little doubt in professional circles that ionospheric tilt mechanics is another important factor contributing to enhanced twilight propagation and reception.

4. Signal Ducting in the Ionosphere:

Conventional views of Tropical Band propagation recognize Chordal Hop, Whispering Gallery and Ducting modes as possible but very exceptional means of shortwave propagation. An ionospheric tilt condition seems to be the common denominator associated with these three phenomena, all of which are associated with twilight propagation.

Simplified views of ionospheric tilt can be seen in Figure B-11 and Figure B-12 appearing on the next page; also refer back to Figure A-6.

(i) CHORDAL HOP

With the right ionospheric tilt condition occurring near the transmitter and a complementary ionospheric tilt present near the receiver, the twilight propagation mode referred to as "Chordal Hop" may occur.

In this situation, when the signal from the transmitter reaches the F layer it is refracted in such a way that it is not immediately bent back towards the earth. Instead, the trajectory of the signal under the F layer is flattened, resulting in an extended skip distance without actually returning to earth. Eventually, the signal is returned to earth, ideally when it encounters a corresponding twilight tilt condition at the receiving end. Since several intermediate hops are eliminated, absorption is greatly reduced so the signal may be much stronger.

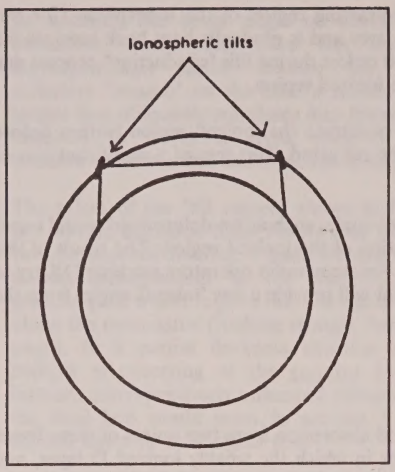

Fig.B-11: CHORDAL HOP PROPAGATION [8]

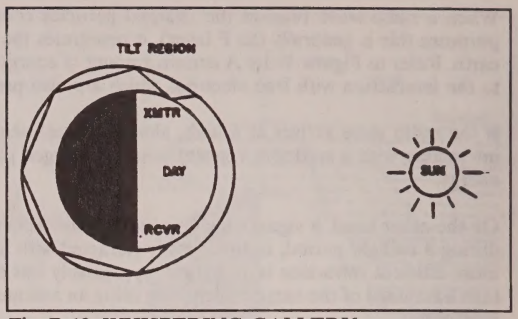

Fig. B-12: WHISPERING GALLERY PROPAGATION [4]

(ii) WHISPERING GALLERY

In this variation of the same general phenomenon, the signal from the transmitter undergoes twilight D layer "deflection" to reach the F layer, whereupon it is initially refracted in such a way that it adopts a multiple refraction mode in the ionosphere and travels an extended distance before returning to earth.

(iii) DUCTING

This is a process of multiple "reflections" between the underside of one layer or sheet and the convex upper side of a lower layer, apparently with minimal absorption. Ideally with the right twilight condition, probably associated with an ionospheric tilt, a strong signal is eventually returned to earth at the receiving end of the path.

In the PROCEEDINGS 1989 article relating to 'The Auroral Factor', Clark discusses why he believes these signal ducting modes may well facilitate enhanced trans-polar propagation on north-south great circle paths crossing the auroral zone from Asia to North America, especially during periods of magnetic storming. Trans-equatorial (south-north) paths from South America may also benefit from ducting phenomena, again seemingly associated with the early stages of a magnetic disturbance.

SEASONALITY

No discussion of Tropical Band propagation from a North American perspective would be complete without some consideration of the seasonal characteristics of weak signal propagation, particularly that from Southeast and South Asian regions. The interesting thing about seasonal peaks is that they seem to be COMMON across most of the continent, notwithstanding that considerations such as partial darkness paths and the auroral factor introduce a high degree of variability in day-to-day reception, depending on the DXer's location.

Throughout North America, Indonesians normally peak near the fall and spring equinoctial periods: mid-September to mid-November and again, mid-February to mid-April. Reception from the Indian Sub-continent, however, is essentially confined to about six weeks per year, centred on mid-December. This is a consistent pattern, notwithstanding the great variation in the great circle and grayline paths from widely separated locations in North America.

There also seems to be a relatively consistent Papua New Guinea season which is basically the "summer" half of the year. Reception in the East does tend to be noticeably better near the Equinox, however, because high static levels during the hemispheric summer frequently mask the PNG's.

Medium wave DXers from the West Coast also note a seasonal swing in the "preferred path" which is generally consistent with our experience on the Tropical Bands. The "Asian Season" for stations from the Southwest Pacific and coastal China is near the Equinox, while other Pacific and 'Down Under' signals are predominate during our summer months - winter in the Southern Hemisphere. Strangely enough, the medium wave "mid-winter anomaly" occurs at the very same time that Tropical Band reception from the Sub-continent exhibits its short, dramatic seasonal peak.

Where does this leave us with the seasonality question? The issue has not been accorded any serious attention in hobby publications. Even with a good deal of searching, the authors have found no scientific or engineering work on the subject either, beyond the simple notion of the cyclic rotation of the day/night terminator. In that regard, we have already noted that seasonal peaks certainly don't necessarily follow the "rules" for grayline paths. This was the clue that eventually caused us to recognize that seasonality seemed to be much more associated with some phenomenon taking place at the transmitter, rather than at the receiver.

UNRESOLVED ISSUES

The foregoing is a general explanation of Tropical Band propagation, largely supported by a variety of respectable sources. In most respects, the conventional view of the mechanics of Tropical Band propagation is a satisfactory "everyday" working model. It has been the accepted view for over half a century and is the basis for many international agreements concerning use of the entire radio spectrum.

But, over some twenty years or so, the authors have observed a number of phenomena which cannot be suitably explained by the conventional view of propagation, especially as it applies to the Tropical Band. Here are three rather consistent reception conundra that remain unresolved:

(1) The mystery behind the distinct seasonality of much of our DX is the central issue. The PNG's are heard in the North American summer (especially in central and west coast areas) when the Pacific and Southeast Asia are about the only areas of Asia in darkness. At the Autumnal Equinox, the season moves west into Indonesia and eventually into the Sub-continent for a short while at mid-winter. By late-January, the seasonal pattern has begun to reverse itself.

Why are the PNG's not heard, except for a few rare mornings, during most of the traditional Tropical Band DX season in North America? There is a darkness path the full distance. We will acknowledge that the winter of 1989-90 was somewhat atypical in this regard.

(2) West Coast DXers in particular have noticed a very interesting fade pattern when listening to a Central or South Pacific stations that operate late into the night. After the initial fade-up and peak at terminator sunset (at the transmitter), signals will usually diminish somewhat and then climb again two to four hours later, centred on 9 PM at the transmitter. This second peak may even be stronger than the initial showing. Why is this so? The path-length is in full darkness at this time.

In this Section we identified the relationship between the time of the dusk terminator and the seasonal peak of Bhutan during the sub-continental season. Can it be that the situation at the transmitter is associated with the seasonality of our DX on the Tropical Band in North America?

(3) Central North American DXers note another phenomenon. For about four weeks centred on the winter solstice, it is possible to hear stations from Central and West Africa. Sometimes this may be sunset enhancement at the receiver; other times, the signal is travelling a total darkness path. In most cases, the signals heard at African signoff (around 2300-2400) are substantially stronger at this early evening hour than the signals from the same transmitter at sign-on (0300-0500) on the same local night. Why is this so? Both receptions are on the same path, usually in total darkness. Even on the East Coast where the Africans are much more consistent, the initial afternoon peak at the receiver very often yields the best reception. We wonder if this phenomenon is also more closely associated with the geophysical situation in the region of the transmitter, rather than at the receiver.

Finally, we remain unsatisfied with the classical explanation of sunrise enhancement at the receiver. The conventional understanding seems plausible on the surface: less attenuation in general and fewer hops due to

tilt geometry. However, for this to work, the geometry would have to conveniently change enough to eliminate a full hop, for example, reduce a four-hop path to three hops. Alternatively, the ionospheric dawn would have to "cut off" or substantially absorb the higher angle rays, allowing only the lower angle ray to reach the receiver unimpeded. The classical multi-hop model of sunrise enhancement at the receiver is shown in Figure B-13 with all regions and wave angles idealized.

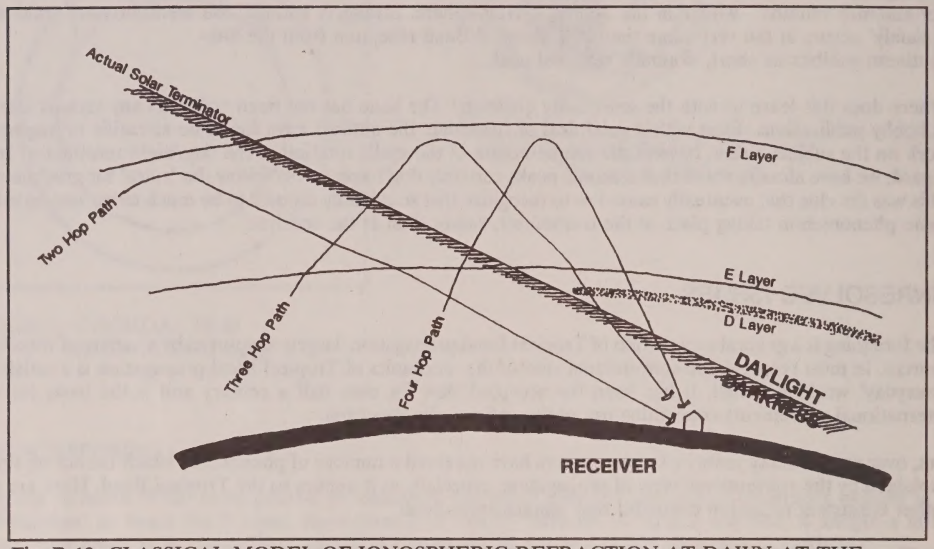

Fig. B-13: CLASSICAL MODEL OF IONOSPHERIC REFRACTION AT DAWN AT THE RECEIVER

Our difficulty with this model stems from the fact that it does not fit with physical reality. We don't believe it adequately accounts for dawn enhancement when the ray path is perpendicular to the terminator and it most certainly can't account for "true grayline" enhancement!

If this model was true to physical reality, before commencement of dawn enhancement the two-hop ray path would mix with the three and four-hop ray paths, regardless of the signal level. We would expect considerable multipath distortion and fading due to different arrival times, at least until the initial formation of the overhead D layer at ionospheric dawn might absorb the downlink of the higher angle paths to the receiver. At best, phase cancellation might sometimes augment and other times decrease the signal level but we would still expect deep fades to occur. Neither do we notice the more rapid flutter fading due to phase shifts typical of HF frequencies of shorter wavelengths. Moderate cyclic fading is of course normally experienced.

Simply stated, in many hundreds of DX sessions at dawn over the years, we have NEVER noticed any form of transitional fading, or distortion, at the beginning of dawn enhancement when signals which were totally absent or barely detectable rise above the receiver noise floor in a very smooth, elevator-like fashion. During good openings, even very low-powered signals such as the Indonesian RPD's with typical power of only one or two hundred watts can sometimes appear in a matter of minutes and reach quite listenable, undistorted levels.

To us, the consistent behavior of Tropical Band signals during dawn enhancement calls the entire conventional explanation of twilight propagation into question.

The three reception conundra cited above and the lack of a satisfactory explanation of twilight enhancement have also been troublesome to other experienced DXers. So, the authors decided to investigate what might exist in the body of knowledge of the scientific world and the practical world of amateur radio that might better explain Tropical Band propagation. The results of our search were startling, to say the least!

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SECTION C

ELECTROMAGNETIC WAVE PROPAGATION BY CONDUCTION [1]

[1] This Section was excerpted from an article by Yuri Blanarovich, VE3BMV, and appears here with the kind permission of the author. Mr. Blanarovich's work originally appeared in CQ Magazine (June, 1980), and was reprinted in his own publication, RadioSporting, in December, 1986.

ABSTRACT -

Mr. Blanarovich draws upon his extensive experience as an amateur radio DX contester to explain why he regards the traditional multi-hop model of skywave propagation as being fundamentally flawed. His main premise is that the ionospheric layers do not so much "reflect" RF energy back to earth at regular intervals as they do refract and "conduct" the energy along the edge of or between two layers at relatively low loss and for much greater distances. Blanarovich cites practical support for his "refraction" model based on experimentation with very highly directional antennas and on determination of optimum takeoff and arrival angles.

Bryant and Clark comment on their reaction to the Blanarovich work, citing general agreement with his observations to the extent they suggest a model which is far more consistent with the authors' own experiences with twilight enhancement as Tropical Band DXers.

Quite often, new advances in technology and measuring equipment can produce some surprising results. In my case, it was the opportunity to advance from wire and vertical antennas into rotatable antennas. Being interested in the mechanics of radio wave propagation, observing the various modes of propagation and trying to put two and two together, I was not always satisfied with available explanations in the literature.

The matter was aggravated when I started to play with high performance antennas: the Razor Beam of my own design. As far as I was able to tell, these antennas produced maximum obtainable gain per given boom length with excellent front-to-side and front-to-back lobes. The real test of the antennas came with the CQ contests when a number of things could be observed that normally would be unnoticed when using "ordinary" antennas. Contests allowed me to observe a number of anomalies and exceptions to present propagation theories by virtue of the great amateur population on the air at the same time all over the world.

The antenna system allowed me to observe various angles of radio wave propagation. The deeper I got into my observations, the more I became convinced that the present theory of electromagnetic wave propagation, which tells us of signals bouncing between the ionosphere and the earth is not entirely consistent and perhaps not valid.

More thinking and sorting out of ideas led to some interesting conclusions that I would like to present here. It is my hope that this article will stir up quite a bit of controversy and discussion, and that it will contribute to the clarification of the matter. Presented here are observations that I was able to collect in the limited time available...more work must be done to collect more accurate supporting evidence.

REFLECTIVE THEORY

The present radio wave propagation theory is based on the assumption that radio waves are propagated by reflections from a mirror-like ionosphere, returning to the earth's surface, bouncing off it back to the ionosphere and so on. Let's call the present propagation theory "reflective".

Reflections are only one possible explanation for getting the signals from the sky at those angles. It is unfortunate that early propagation scientists such as Heaviside, Appleton, Briet and Tuve apparently did not get exposed to more of the work that was being done in optics at that time. In 1870, John Tyndall presented the earliest recorded scientific demonstration of a peculiar optical phenomenon: light being trapped in a stream of water. In his demonstration he showed that when a stream of light was allowed to flow through a hole in the side of the vessel, light was conducted along the curved path of the stream, This was the closest thing to fibre optics. Too bad they did not see the similarity between radio waves and light and get the idea of another way of propagating radio waves. Today we know that light is on the high end of the electromagnetic spectrum.
So this was a handy explanation: "mirrors in the sky" reflecting radio waves back to earth. The generally accepted idea has carried to the present day and any anomalies have been judged as exceptions. All kinds of explanations have been tried in order to explain the mechanics of unusual propagation modes.

A CRITICAL LOOK

Let's have a look at the reflective theory and see how well it fits real life. The first thing that really hit me is that the earth is usually drawn on one scale and the ionospheric layers are drawn to another scale, about 10x (Figure C-1). It explains how signals might reflect but does not approximate the real geometric condition.

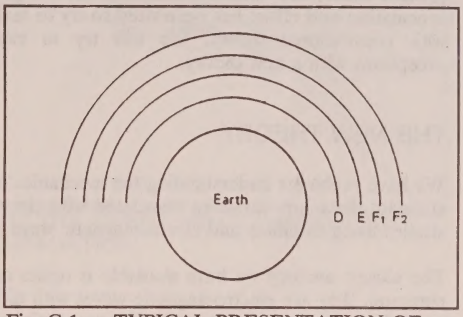

Fig. C-1: TYPICAL PRESENTATION OF IONOSPHERIC LAYERS

When the earth and the ionospheric layers are drawn to scale, it seems that we need about four hops to propagate a signal one quarter way around the world (assuming an average launch angle of 11 degrees and F2 layer height of about 500 km on a summer day). Working Europe on long path would require about twelve hops. Considering the natural dispersion of the signal with distance and loss per reflection off the ionosphere and the earth, it seems to me that it is very unlikely that we could have any signal left at the other end (Figure C-2).

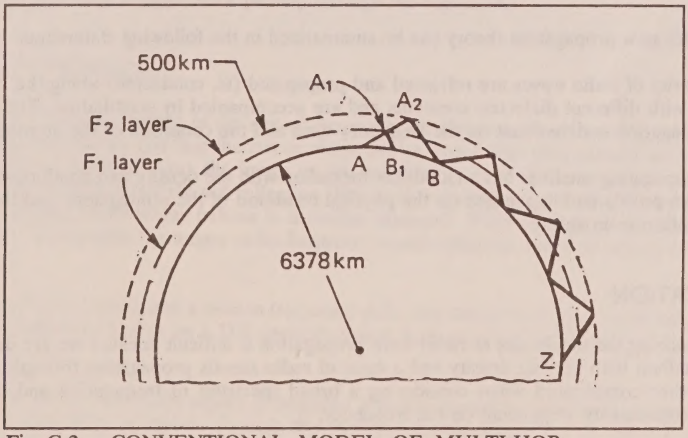

Fig. C-2: CONVENTIONAL MODEL OF MULTI-HOP PROPAGATION WITH THE EARTH AND IONOSPHERE DRAWN TO SCALE

The typical picture of the mechanics of reflection from the ionosphere (Figure C-3) is also questionable. In order to reflect signals, one would expect a good reflective surface, larger than the wavelength and of good conductivity

with a clearly defined surface border. But we know the ionosphere is very thin and the molecules are widely separated.

I find it hard to believe we can get sufficient reflection of signals from that type of medium to yield the signal levels that can be experienced. The shape of the curve is also very unusual - it looks like refraction over about 270 degrees. In reality, the ionosphere would rather absorb the signal energy than "turn it around".

Various propagation modes that cannot be explained by present theory are labelled exceptions and a great deal of speculation and effort has been used to try to make them fit with conventional theory. We will try to explain these exceptions with a new theory.

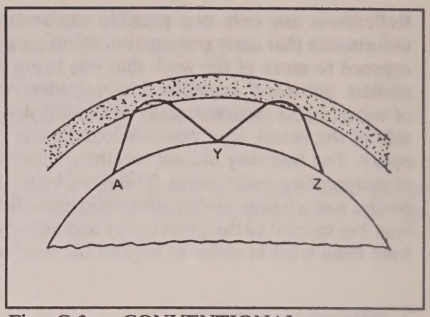

Fig. C-3: CONVENTIONAL REPRESENTATION OF IONOSPHERIC REFECTION

THE NEW THEORY

We have problems understanding the mechanics of radio wave propagation because it is virtually impossible to simulate the many variables associated with the real situation in a laboratory setup. The best we can do are studies using satellites and electromagnetic wave sources in space or here on earth.

The closest analogy we have available is optics and fiber optics. Radio waves and light do have one thing in common: they are electromagnetic waves with different wavelengths. Recent advances in fiber optics can help us understand the behavior of light propagation, as well as radio waves. But it still difficult to make a good analogy because of the many variables in the atmosphere and the biggest contributor to ionospheric variations is radiation from space, mainly from the sun.

When looking for a better explanation of radio wave propagation, it struck me that there must be more "conduction" going on up there than reflection. As a result of my observations over a number of years, I came to the conclusion that radio waves propagate in a medium that resembles a cloud or a cross between a cloud and fiber optics.

The basics of this new propagation theory can be summarized in the following statements:

> A majority of radio waves are refracted and propagated (ie. conducted) along the borders of media with different dielectric constants and are accompanied by scintillation. The geometry of propagation is dependent on the frequency used and the condition of the atmosphere.
>
> The propagating medium has a cloud-like formation with the density and conductivity varying along its profile and dependent on the physical condition of the atmosphere and the amount of radiation from space.

INTERPRETATION

Accurately visualizing the mechanics of radio wave propagation is difficult because we are dealing with a three dimensional medium with varying density and a cone of radio signals propagating through that medium. The situation is further complicated when considering a broad spectrum of frequencies and different angles of refraction and conductivity, dependent on the frequency.

In Figure C-4 we have the earth and the ionosphere drawn to scale. To simplify matters, the beam of transmitted radio signal will be shown as a ray: using a solid line for a strong signal, a broken line for a medium strength signal and a dotted lone for a weak signal. Ionospheric density or radio conductivity will be shown as a heavier shaded area for good conductivity and with a lighter shading for poorer conductivity.

The signal is transmitted from point A. Line of sight strength decreases after point B. But the main lobe of the antenna puts most of the signal into the atmosphere and refraction begins at point C. A portion of the signal gets refracted immediately and a portion passes through to point D. Then the refracted signal continues through

points E, G and H, more or less following the curvature of the earth. Scintillation along the path is noticed as backscatter and sidescatter. A portion of the signal is refracted back to earth and received at points W, X, Y and Z. At point D, a major part of the signal was refracted but a portion continues through D to point F where it either now gets refracted or continues on into space. A portion of the refracted signal on the higher path can be refracted back to earth at point K, at a different angle. It may combine with the signal propagated by the lower path, causing considerable fading.

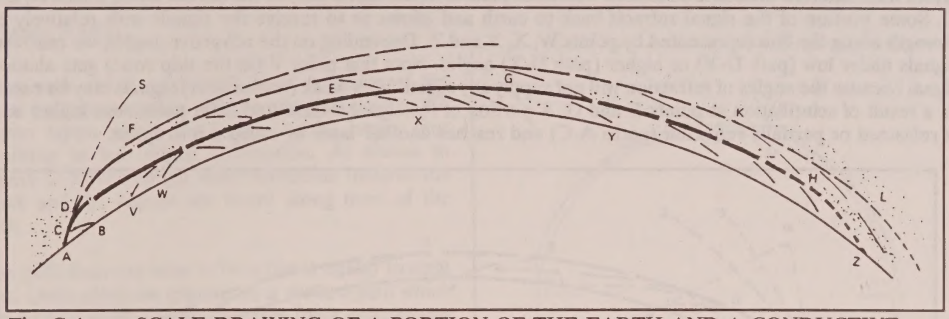

Fig. C-4: SCALE DRAWING OF A PORTION OF THE EARTH AND A CONDUCTIVE IONOSPHERE SHOWING WAVE PROPAGATION

In real life, the situation is rather more complicated due to the wider beam-width of the transmitted signal, irregularities in the medium and the range of frequencies and angles of the transmitted signal. There is also an indication that the rate of travel of the radio waves can vary in different layers, and this, combined with the scintillation or scattering of the signal, can be observed as a Doppler shift of the signal's frequency.

Scintillation in this case can be compared to the situation where we have a strong source of light with its beam going through a patch of fog. Particles of fog will be glowing or scintillating and become visible. A portion of the beam will continue to propagate after passing through the fog patch.

SUPPORTING EVIDENCE

When observing the rising or setting of the sun or the moon, we observe refraction of light in the layers of the atmosphere. It is a well-known fact that the sun or moon can be "seen" after they actually set below the horizon, the lag being about 12 minutes. Also, the image or the size of the sun or the moon quite often appears to be larger than normal. This is definitely not reflection. We do not see the "mirror image", but rather the actual "picture". Why shouldn't radio waves behave in a similar manner? Whereas light is an electromagnetic wave having a very short wavelength, the longer radio frequency wavelengths are easier to refract or bend, but harder to reflect.

During overseas contacts, sometimes a sudden frequency shift, very similar to what we call "selective fading", can be noticed. I have observed fading on a DX contact's signal, accompanied by a slight shift in the frequency of his signal.

The familiar "arctic flutter" and raspy signals propagated from the aurora are another example of the frequency shift caused by propagation of signals through the medium. Arctic flutter can be simulated by tuning two receivers to the same signal and then slightly detuning one receiver's VFO. The signal will sound as if it has just passed over the Pole with familiar flutter. Signals propagated through the auroral region exhibit multiple frequency shift. Another noticeable feature of this frequency shift is the absence of the higher notes in the audio response of the shifted signals.

One important thing is apparent from these observations. When one is calibrating a receiver to WWV and his location is such that he is receiving a backscatter signal, then there is a good chance that he might be slightly off the absolute frequency. [Mr. Blanarovich makes reference to frequency shifts in the order of 500 Hz, although this would be a much greater magnitude that is mentioned in any professional sources we have found.]

Let's assume for now that signals are propagated by conduction rather than reflections and we will look at the various modes to see how well they fit the theory.

SHORT PATH

We again assume a single ray of radio signal in Figure C-5 which shows a signal transmitted from point A. The skywave ray gradually bends (refracts) through the atmosphere until reaching point D - a distinct border of two layers with different dielectric constants. The main portion of the signal follows the border along points D, E and G. Some portion of the signal refracts back to earth and allows us to receive the signals with relatively even strength along the line represented by points W, X, Y and Z. Depending on the refractive angles, we can receive signals under low (path D-Y) or higher (path D-X) angles. Note that point V (in the skip zone) gets almost no signal because the angles of refraction will not supply any signal. Very weak (backscatter) signals may be received as a result of scintillation at points E and G. A portion of the signal transmitted from point A at higher angles is refracted or partially refracted (paths A-C) and reaches another layer or escapes into space.

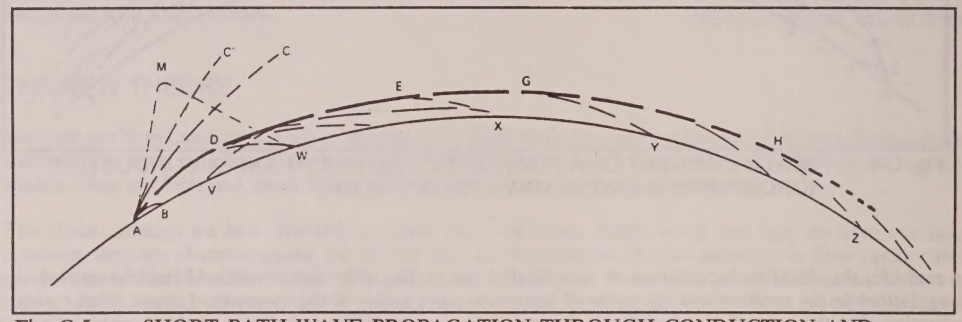

Fig. C-5: SHORT PATH WAVE PROPAGATION THROUGH CONDUCTION AND REFRACTION

Whereas the dotted line shows the path A-M-W as explained by the reflective theory, it appears that we are actually propagating the main portion of the signal at considerably lower heights than previously thought. Having antennas with low angles of radiation extends the useful range of propagation under adverse conditions with lower angles or refraction.

DAY - NIGHT VARIATIONS

Figure C-6 shows a signal being radiated on a 45 degree bearing from Ontario, across Europe to Asia. It's early morning in North America, the sun is over Europe and it's evening in Asia. The atmosphere is warmed by the sun's radiation, raising the height of the layers over Europe and changing the dielectric constant of the media affecting the refractive angles. The "hump" over Europe causes the signal to change its direction and at about 1400 local time, only weak signals, mainly resulting from scintillation, are audible in that area. Ontario and Asia have no problem communicating, with conditions actually peaking between the two points. This is a changing situation with time of day, radiation from the sun, frequency and angles of refraction. The example given is typical for the higher frequencies in the range of 14 to 30 MHz.

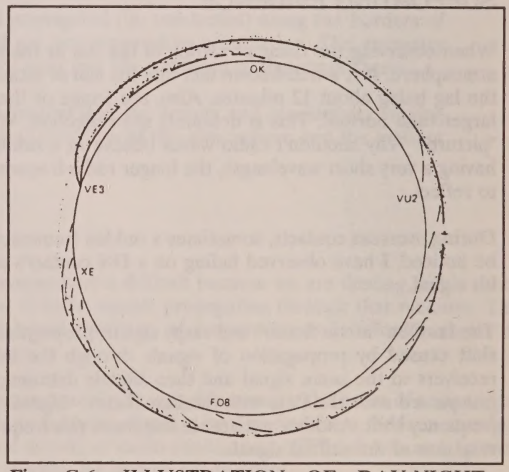

Fig. C-6: ILLUSTRATION OF DAY-NIGHT VARIATIONS IN PROPAGATION

It is known that with increased sunspot activity, the thickness (electron density) of the ionosphere increases. The height of the propagating layers also increases, and

thus increases the height and length of the signal "arch", allowing us to span longer distances and propagation on the higher frequencies is extended later into the night.

We have been told that during peaks of solar activity, the lower bands are very poor, due mainly to D layer absorption. But at night the D layer disappears and at time of writing (1980), propagation on the lower bands has been better than what we experienced during the sunspot minima. It appears again that the (nighttime) refracting layers are higher, allowing us to work longer distances with stronger signal levels.

LONG PATH

Long path can be explained as an extension of the short path propagation with the signals following the higher layers where the losses can be lower, thus resulting in less signal attenuation. As shown in Figure C-7, we still get some refraction towards the earth and the signals are heard along most of the path.

The path does not have to be a (great circle) straight line. Quite often we experience a skewed path which can be the result of side refraction (with quite strong signals) or the result of scintillation (with weak signals at low angles).

The best case of long path would be the situation whereby signals get "trapped" in layers with low attenuation and travel a number of times around the earth, causing long delayed echoes.

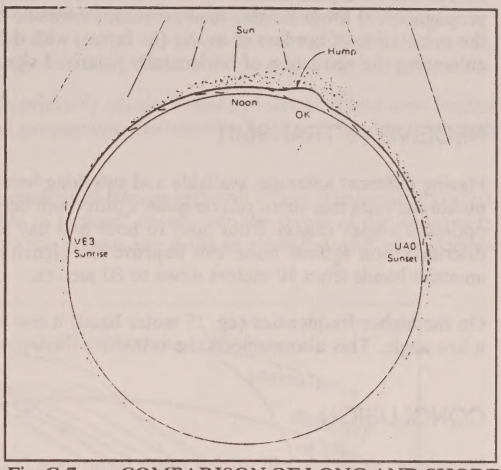

Fig. C-7: COMPARISON OF LONG AND SHORT PATH PROPAGATION

GRAY LINE PROPAGATION

Here we have the case where the medium is more or less at the same height, the refractive layers are more uniform - without major humps, and this allows us to propagate signals along that path over a wide range of frequencies with relatively little attenuation or refraction in the unwanted directions. Again, low angle antennas should perform best.

When signals are aimed in the direction of the gray line, just about any point on earth on the gray line can be communicated with, especially at the lower frequencies.

ONE WAY PROPAGATION

Quite often we experience basically one way propagation. For example, in the late afternoon, strong signals are heard on the 40 meter amateur band from Europe but it is nearly impossible to work the Europeans from North America, either with high or low angle antennas. Later on, signals become stronger on a low angle antenna and contacts become possible.

This can be explained by scintillation, such as we see on the end of a fiber optic fiber. When light exits a fiber and the exit end of the fiber is ragged rather than smooth or when there are impurities in the fiber at the exit point, the light is dispersed at broad and random angles as it exits. Under those circumstances, it is easy to visualize the impossibility of returning light along the same route to the original source. A similar situation can exist with radio signals and the conducting layers.

Another form of one way propagation is caused by different refractive indexes at each end of the path. Going in one direction, signals can be refracted gradually and due to local conditions at the other end they can exit or be refracted towards the earth. For the transmitted signal, the angle of refraction can be different and the ionosphere will not refract the transmitted signal into the same layer that the received signal is being propagated.

TRANSEQUATORIAL AND OTHER VHF PROPAGATION

This type of propagation was discovered when stations located close to the same meridian were able to work each other across the equator. This propagation usually peaks just after sunset and appears to be another form of gray line propagation where we have a uniform medium with gradually changing height near the equator resulting in propagation over great distances. I would predict that given good conditions, it might be possible to establish contacts on the 2 meter band between Ontario and Argentina.

If refraction replaces reflection and scintillation replaces scatter, then many of the "unusual" VHF propagation modes can be explained and better understood. Horizontal polarization seems to be better for long haul VHF propagation at lower heights than previously assumed based on reflection. This is probably due to the fact that the orientation of borders of media (ie. layers) with different dielectric constants are oriented horizontally, thus enhancing the refraction of horizontally polarized signals.

RECEIVE vs TRANSMIT

Having different antennas available and switching between higher and low angle antennas, I have found during numerous tests that there can be quite a difference between the angles of transmitted and received signals. The optimum angles change from hour to hour and day to day too. In addition, choosing the optimum angle for discrimination against noise can improve the signal-noise ratio tremendously.This has been observed on all amateur bands from 10 meters down to 80 meters.

On the higher frequencies (eg. 15 meter band) it has been found that most "short skip" signals are strongest at a low angle. This also supports the refractive theory.

CONCLUSION

Hopefully this article will inspire hams, [shortwave DXers] and scientific institutions to do more in-depth study which will eventually enable us to make more sense of radio wave propagation with fewer exceptions, and to develop more reliable means of forecasting propagation based on the factors known to affect it. Let's not be afraid to challenge a long-accepted theory.

What I have tried to present in this article is an expression of what I feel, what I have observed and what I feel makes sense. I find it quite difficult to describe or express exactly what I have been experiencing. This is partially due to the absence of a good clean analogy, and partially due to the difficulty in verifying and expressing accurately what is happening up there.

I hope that I have succeeded in getting my main message across: maybe there are no mirrors up there but more likely something like layers or clouds which can conduct or refract radio waves.

COMMENT: By Bryant and Clark

When we first discovered this article a decade after its original publication, we were reminded of how little information actually flows from one part of the radio hobby to another; we were also reminded that since WWII, practically none has flowed either way between the "hobby" and "professional" worlds. This was not true in the early days of radio and is not the case today in some areas of endeavour, such as naval architecture, aeronautical engineering and automotive design. We are each less knowledgeable because of these artificial barriers.

The responses to Mr. Blanarovich's article at initial and second publication were quite curious. They seem to fall into one of three camps:

1. The traditionalists steadfastly maintained that "the experts can't be wrong", so multi-hop must be the primary mode of skywave radio propagation. They are obviously unaware of the change of stance of the CCIR and the ITU regarding propagation beyond 10,000 km. In 1978, the "experts" had already changed their minds, at least concerning long haul propagation.

2. The muted response of the second camp was: "Big deal, it's been in the Handbook since the early days". This group misses the point entirely. Blanarovich contends that the mode known variously as "Chordal Hop, Whispering Gallery or Single-sided Ducting" is not a rare, exceptional mode of propagation, rather, it is the NORMAL, and maybe only mode. To our knowledge, no one in the hobby has taken that radical a stance before.

3. The third group of respondents, very few in 1980 but in increasing numbers after the 1986 re-print, acknowledged that Blanarovich's observations matched their own propagational experiences much more closely than the classical multi-hop model. They are inclined to agree that the author is on the right track in terms of "what's really happening up there".

Our reaction is this:

If HF radio propagation, at least on the Tropical Band, is primarily accomplished by refraction into near-lossless sheet-like layers, the five modes of terminator-enhanced propagation discussed in Section B become eminently understandable.

If we assume the geophysical reality underlying the observations of Blanarovich and others is essentially correct, we can also visualize a transmitter in darkness being able to "upload" energy into the layers of the ionosphere. Let's take another look at the refraction model showing the various ray paths or takeoff angles of a skywave signal entering the ionosphere:

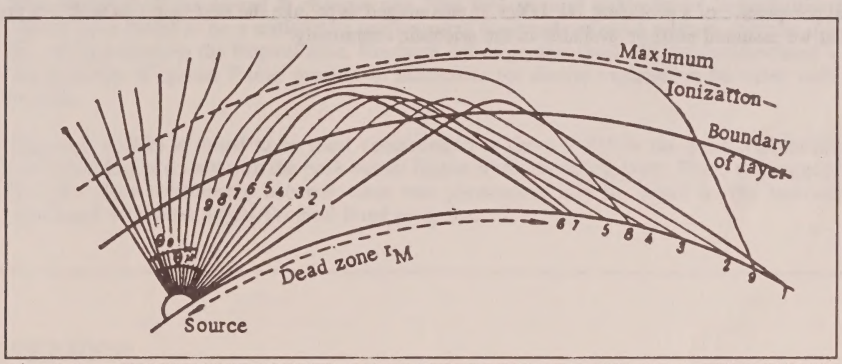

Fig. C-8: SINGLE-HOP MODEL OF TRAJECTORY OF RAYS OF A SHORTWAVE SIGNAL

Consider the 9th ray in Figure C-8, repeated from Section A. Once it is travelling in a sheet or layer parallel to the horizon, there is no obvious reason for it to come down, unless it strikes an irregularity and is randomly refracted downward; or, UNLESS THE IONOSPHERE IS TILTED and the signal is "dumped" down to the waiting receiver. In that case, it is plausible to comprehend the kinds of reception that Tropical Band DXers experience consistently. Consider the following three suppositions:

1. Assume that "uploading" from the transmitter in an all-darkness situation is fairly inefficient. A dependence on random irregularities to refract the signal back down to a receiver in full darkness is also inefficient. This mode would only work well relatively close to the transmitter ("one or two hop" distances) and would work very poorly at longer distances. Most of the time at those longer distances, a signal on a full darkness path would not rise above the noise floor of the receiver. At least that would be the case for weak, Tropical Band signals travelling 8,000 miles and more from Asia.

2. At the twilight "tilts" of the ionosphere, assume that the layers or sheets are "more exposed" and that uploading is a highly efficient operation during that brief time when either sunrise or sunset twilight is occurring at the transmitter. Then, we can easily understand the sunrise and sunset AT THE TRANSMITTER enhancements.

3. Assume that the twilight tilt of the ionosphere at dawn and dusk also causes a dumping of the signal at a relatively low angle above the horizon. The sunrise and sunset AT THE RECEIVER enhancement modes then also become understandable.

The authors recognize that Mr. Blanarovich's work is controversial but that doesn't mean we should dismiss it! We do not suggest that he is proposing a revolutionary, unsubstantiated new theory of propagation. Rather, we credit a non-professional hobbyist like ourselves who has grappled with the thorny problem of proposing a MODEL for long haul propagation which fits reality. It is hardly surprising that we would witness a conflict between the academic, "theoretician's interpretation" and the rough and tumble, real-world "radioman's interpretation". As a very successful DXer, Blanarovich certainly qualifies as one who can speak from experience.

If the complex geophysical variables which govern shortwave propagation were well-understood, even in professional circles, this article in Proceedings would likely be without purpose. For the very reason that our understanding lacks precision, any proposed analogue, such as Blanarovich's use of the optical fibre analogy, is at best a compromise and open to criticism. We would point out, however, that in the course of our own investigations we have found more than fifty major articles published by the IEEE in recent years which use the optics/radio propagation analogy. That discourse continues to this day! Perhaps Blanarovich was ahead of his time because he certainly didn't have the benefit of a number of professional articles written within the past six years which focus on the ionosphere as a vast array of layered sheets, or which discuss ionospheric irregularities in great detail.

The Blanarovich article was of value to the present authors because it offered a viewpoint based on the very practical perspective of a proficient HF DXer. It encouraged us to take the next step - to seek out professional work that we assumed must be available in the scientific community.

A TROPICAL BAND DXER'S GUIDE TO THE IONOSPHERE: DIURNAL EFFECTS AND TROPICAL ZONE IRREGULARITIES

ABSTRACT -

In pursuit of a better explanation for dawn/dusk enhancements and the seasonal characteristics of Tropical Band propagation, the authors expand their study of the geophysical characteristics of the F region in equatorial latitudes, since this region is the origin of the vast majority of the DX signals.

The diurnal variations in the equatorial F layer are examined. One principal characteristic is found to be the rapid changes in vertical height of the layer in the six hour period between sunset and midnight. A sharp rise to a peak height in mid-evening is identified.

Drawing heavily on research papers presented to a conference of The Advisory Group for Aerospace Research and Development of NATO, the authors investigate the principal characteristics of the spread F phenomenon. The formation of field aligned irregularities (or spread F) is found to be a statistically regular event in periods of quiet magnetic activity during the evening hours in the tropical zone. Research indicates that signal conduction associated with the presence of spread F may provide an alternative yet similar explanation for other ducting models.

Spread F activity is found to be most concentrated at about 9 PM in the equatorial latitudes, corresponding precisely with the peak virtual height of the refracting layer. There is a suggestion that the close relationship between these two phenomena may be linked to the seasonality associated with weak signal Tropical Band reception.

INTRODUCTION

Most of us have stared at our receivers very late at night and wondered about the extent to which the unusual propagation that we have observed closely over the years had a basis in the current body of knowledge.

In Sections A and B, the major physical attributes of the ionosphere were discussed. Processes such as spherical divergence/convergence and tilts were noted. These two Sections together examined geophysical inter-relationships between the earth and the ionosphere and how certain of those may enhance long haul Tropical Band propagation, especially over partial darkness paths. In so-doing, the authors have challenged the long held belief which recognizes the multi-hop model as the "normal" mode of HF radio propagation. The Blanarovich "conduction" model presented in Section C continues to develop that theme.

So, for the dedicated Tropical Band DXer, we surmised that further investigation into the geophysical characteristics of the F layer in particular might lead us to a better understanding.

Although most of the DXers reading this article probably live in the mid-latitude temperate zone, the vast majority of our Tropical Band DX originates in the low latitude equatorial zone, so this is where we have focussed our efforts.

DIURNAL CHANGES IN THE IONOSPHERE

Any description of the ionosphere records the formation of the D layer at local dawn, the partial solar control of the E layer, and the split of the F layer into the F-l and F-2 layers as regular diurnal ionospheric changes. The converse processes occur at dusk.

Only a few hobby sources make passing reference to the fact that the virtual height (h'F) of the F layer varies radically and with great speed at certain predictable times of the local day (differing also as a function of latitude). Virtual height (h'F) is the height at which signals, by geometry, appear to be "reflected" from the ionosphere. It is determined by measuring the angles of take-off and arrival.

We are unsure why this radical change in our main refracting medium has been given such superficial treatment. h'F is covered here at some length because this factor could be one of the primary driving forces in the changing propagation we notice, especially during the all-important twilight periods discussed in Section B.

The virtual height of the ionosphere changes at different rates and times in the tropics, in the temperate zones and at polar latitudes. Since most of our propagation paths travel through at least two of these zones, the relationship of DX signal paths to the changing heights of the ionosphere is quite complex.

Jacobs and Cohen contribute the classic secondary source information on h'F:

> "During the daylight hours, there are two well-defined regions: the F-1 layer, which begins slightly above the upper boundary of the E layer at about 150 km, and extends up to about 250 km, and the F2 layer, whose height varies seasonally, ranging up to about 350 km during the winter and close to 500 km during the summer.
>
> Although more highly ionized, the F1 layer behaves very much like the E layer. Maximum ionization occurs near noon when the sun is most directly overhead, and the layer disappears during the hours of darkness.
>
> Unlike the other layers, ionization in the F2 region exists at all times. This region is the most highly ionized and most important of the ionospheric layers. During the nighttime hours, the F2 layer height varies approximately between 250 and 420 km. Because the recombination rate in this region is relatively slow, the layer exists around the clock. Were it not for this fact, long-distance short-wave radio communication would be virtually impossible during the hours of darkness." [1]

EQUATORIAL VIRTUAL HEIGHT

Figure D-1 illustrates the virtual height of the F layer above Ibadan, Nigeria (at 7 degrees, 22 minutes N.; 3 degrees, 58 minutes E.) in the International Geophysical Year (IGY) of 1957-58.

The curve connecting small, solid DOTS represents magnetically disturbed days; the more volatile curve connecting open CIRCLES represents magnetically quiet days. (Please note these Legend criteria, as they apply to several of the illustrations to follow.)

Note that the vertical movement at initiation (at, or soon after sunset) is almost 200 km/hour until a peak is reached at about 2200. Note also that the virtual height returns to the approximate 250 km height by local midnight during about 60% of the year and stays elevated somewhat later into the post-midnight hours during the Northern summer. As the night progresses, the height gradually declines, reaching its lowest level just prior to dawn.

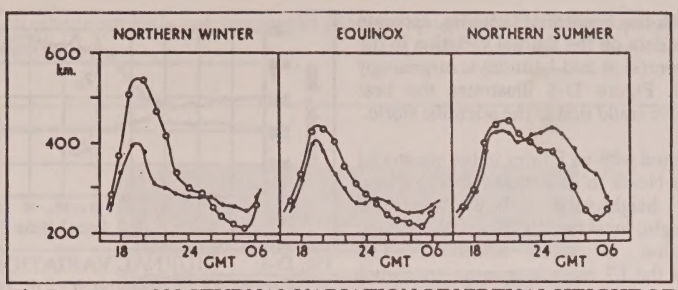

Fig. D-1: NOCTURNAL VARIATION OF VIRTUAL HEIGHT OF F LAYER (Ibadan, 1957-58) [2]

Figure D-2 is also from studies made during the IGY and tells the same story for three rather widely scattered Pacific Island locations at the Equinox. The picture is identical: rapid vertical acceleration of the F layer at dusk followed by an almost symmetrical decline to 250 km by local midnight. We should note that the IGY was the Cycle 19 sunspot-maximum year, still the highest cycle on record.

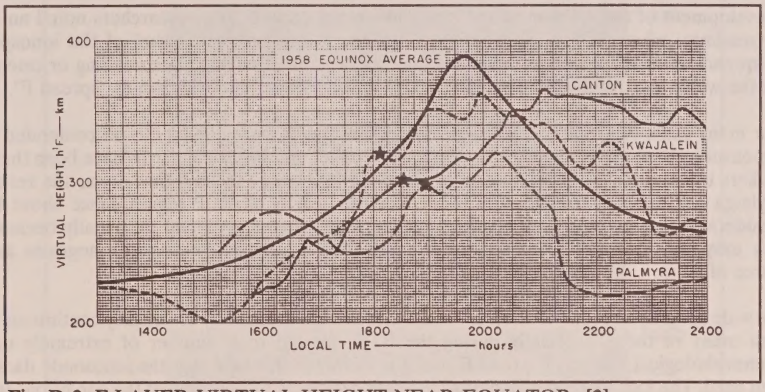

Fig. D-2: F LAYER VIRTUAL HEIGHT NEAR EQUATOR [3]

Authorities have identified two other factors which influence the rise in equatorial virtual height of the F layer during the early evening hours:

> "The rapid change of the virtual height of the F layer (h'F) at 1800 local time, is not necessarily entirely due to an actual vertical motion. Two other mechanisms which are known to be present will contribute to the rise. First, there is the 'eating away' of the bottom of the F layer by recombination due to the higher recombination coefficient lower down and solar radiation is no longer producing ionization to replace it. [The authors take the foregoing to at least partly refer to the dissolution of the F-1 layer at dusk.]
>
> Secondly, in equatorial latitudes in the day hemisphere, the ionospheric drift motions [of patches and irregularities] are from East to West and in the night hemisphere they are from West to East. If these motions represent real motions of ionization, then there will be a further loss of ionization due to the divergence [change of direction] of horizontal drift around this time of day. The influence of cooling may also affect the situation. The actual contribution of all of these effects to the F layer rise is still uncertain." [2]

As compared with the equatorial latitudes, accurate primary research data on the diurnal variation in the height of the F layer(s) at mid-latitudes is surprisingly difficult to find. Figure D-3 illustrates the best information that we could find in the scientific world.

So, we are presented with an F layer in the equatorial zone (25 degrees North to 25 degrees South) whose effective (virtual) height varies radically between 6 PM and 12 midnight, local time. The temperate zone F layer situation is more uncertain. The disappearance of the F1 zone may cause an abrupt upward shift in the effective height. Figure D-3 indicates that F2 maximum slowly comes to rest at 200-300km at about 10 PM local time.

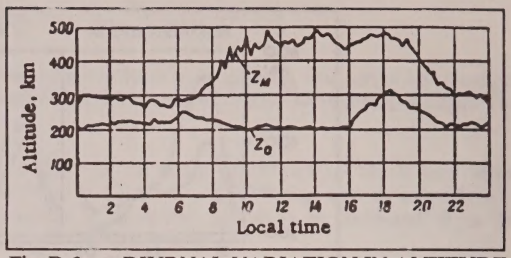

Fig. D-3: DIURNAL VARIATION IN ALTITUDE OF BEGINNING OF THE F-2 REGION AND ALTITUDE OF THE F-2 MAXIMUM. [4]

It should be interesting to Tropical Band DXers that this rapid vertical movement of the F layer AFTER DARKNESS and IN THE TROPICS does not seem to have been previously been discussed as it relates to our hobby! What's more, the occurrence of this movement bears a strikingly close relationship to the incidence of another phenomenon which has received scant attention except in isolated professional circles and yet may be very important to all Tropical Band DXers.

THE PHENOMENON OF "SPREAD F"

From the development of the ionosonde and ionogram in the early 1930's, researchers noted an aberration in the F layer readings: when using the ionogram, often the rather precise "layers" of the ionosphere became smeared or spread. Since the image of the layers denotes the refracting layer, a spreading or smearing denoted increases in the width and depth of the refracting region. This condition is known as "spread F".

> "For many years this phenomenon was considered mainly as a difficulty to be contended with in measuring such parameters as h'F and foF2. Booker and Wells appear to have been the first workers to consider the possible causes of spread F. They concluded that it was the result of Rayleigh scattering by irregularities in the electron density of the F region. Since about 1948, considerable interest has been centered on the study of spread F, and principally because of their easy availability, most of the work in this field has been done using ionograms as the source of data.
>
> The wide geographical distribution of ionosondes and the availability of virtually continuous data from many of them, especially during the IGY, has led to a number of extremely useful geomorphological studies of spread F, and it is mainly in this field that the ionosonde data has been used. The ionosonde has also provided useful data regarding some of the conditions in the ionosphere before and during the occurrence of spread F.
>
> However, although the ionosonde is able to provide much useful information, it is basically unsuited to a detailed study of the irregularities which cause spread F. Indeed, so far as the ionogram is concerned, spread F is a disturbance which degrades the quality of the data to be obtained from it, and for this reason the sensitivity of ionosondes is usually adjusted to minimize the effects of spread F...As a result of these difficulties encountered when using ionograms as source of data a number of more specific experiments have been conducted. SEVERAL PHENOMENA RELATED TO THE PROPAGATION OF RADIO WAVES IN THE F REGION ARE CLOSELY CORRELATED WITH THE OCCURRENCE OF SPREAD F ON IONOGRAMS.
>
> It is now believed that these phenomena are the result of the same basic mechanism in the ionosphere. The term "spread F" has in fact come to describe the ionospheric condition rather than just its manifestation of the ionogram, which must now be considered as merely one aspect of spread F." [2]

Figure D-4 is an excellent illustration of the onset of the spread F phenomenon. The top two ionograms, taken at 1740 and 1750 local time, are classical representations of the "stable" ionosphere. Moving down the sequence

of photo's in 6 to 10 minute intervals, one can see the phenomenon grow to full flower by 1843 local time, in this case at Ibadan, Nigeria.

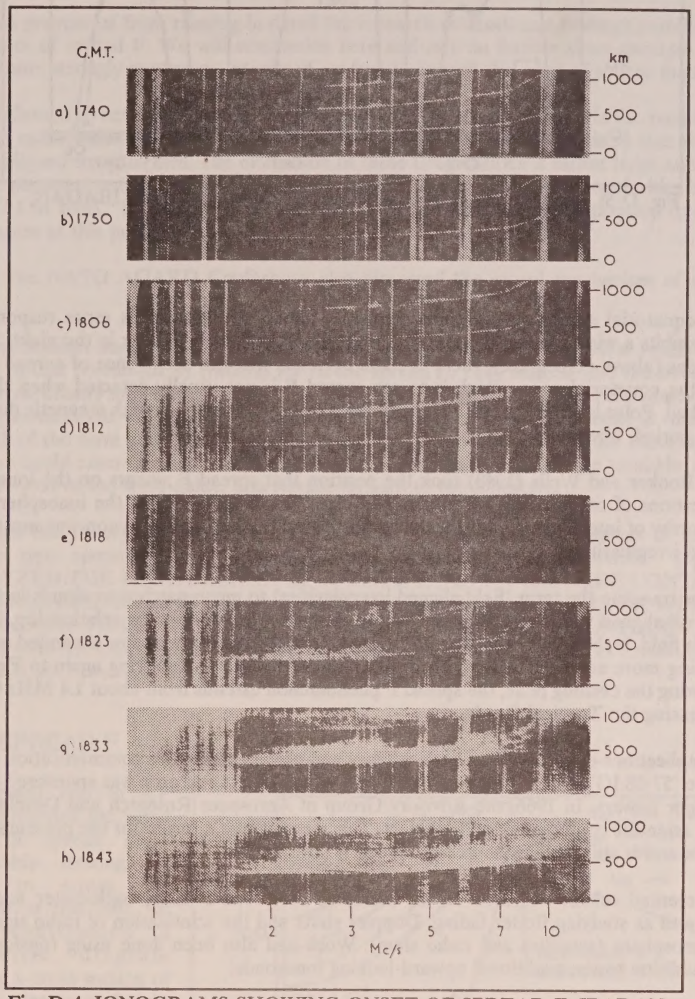

Fig. D-4: IONOGRAMS SHOWING ONSET OF SPREAD F, IBADAN SUNSPOT MAXIMUM [2]

The occurrence of spread F is neither isolated nor unusual. Figure D-5 illustrates the percentage of occurrence during the IGY over Ibadan, Nigeria. When it is winter season in the northern hemisphere, spread F occurs on more than 90% of the magnetically quiet evenings. Note the seasonal variation associated with the occurrence of spread F during magnetically disturbed conditions: most prevalent during the northern hemispheric summer and quite infrequent at the Equinox. Finally, note in particular that spread F occurs in the equatorial latitudes ONLY at night and that the concentration of occurrences is highest around 9 to 10 PM local time during much of the year.

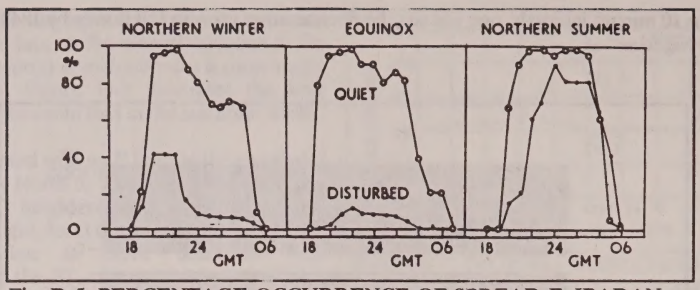

Fig. D-5: PERCENTAGE OCCURRENCE OF SPREAD F, IBADAN, 1957-8 [2]

In contrast to equatorial spread F, the phenomenon at temperate latitudes is more responsive to magnetic disturbances, exhibits a winter maximum and the peak period of activity is later in the night. However, at high magnetic latitudes (above 60 degrees), there is some evidence that the occurrence of spread F co-relates with the pattern in the equatorial zone, which is to say spread F is not usually detected when the magnetic field becomes disturbed. Polar latitude spread F does exhibit a positive co-relation with magnetic disturbances during the equinoctial period, however.

Early work by Booker and Wells (1948) took the position that spread F smears on the ionograms should be viewed as indications of other not-as-yet-understood elements or processes of the ionosphere, and that these smears were worthy of intense study. Further, they postulated that the phenomenon was most probably caused by "field aligned irregularities."

Most authorities translate the term "field aligned irregularities" to mean patches or clouds in the F layer whose major axes are all aligned with each other and whose alignment has some clear relationship, ie. parallel, to the earth's magnetic field. It should be noted that these irregularities are heightened or expanded areas of refraction: they are returning more echo over a broader area to the earth station. Referring again to Figure D-4, we also observe that during the evening peak, the spread F phenomenon extends from about 1.4 MHz to about 10 MHz, totally encompassing the Tropical Bands.

The possible implications of spread F on both military and civilian shortwave communication sparked intensive study during the '57-58 IGY and throughout the 1960's. Much of this research was sponsored by the military of each of the major powers. In 1966, the Advisory Group of Aerospace Research and Development of NATO hosted a major scientific conference on the subject. This meeting was a forum for the presentation of numerous scholarly papers and is still a major source of spread F information.

The papers presented related research on the elements of spread F using backscatter and forward scatter techniques, as well as studying flutter fading, Doppler shifts and the scintillation of radio signals from sources beyond our atmosphere (satellites and radio stars). Work had also been done using topside soundings from spacecraft, in addition to the traditional upward-looking ionosonde.

MECHANISMS OF SPREAD F

> "Spread F displayed on ionograms taken at equatorial locations varies considerably in its appearance. It would seem, however, that two basic categories exist, and that these are the result of two fundamentally different mechanisms.
>
> The two basic forms have been termed range spreading or equatorial type spread F, and frequency spreading or temperate latitude-type spread F....Equatorial type spread F is characterized by a general widening and diffusion in range of the normal F layer echo on ionograms. This diffusion may extend from the lowest to the highest frequencies at which echoes are observed, and during its presence the effects of group retardation near to foF2 may be partially or, more usually, completely obliterated.

When only temperate latitude type spread F is present, the low frequency part of the ionogram may be little changed, and the presence of spread F indicated only by the appearance of that part of the ionogram near to foF2." [2]

Space limitations prevent us from relating in detail the research methods and findings pertaining to the causes and characteristics of spread F. We will summarize here and rely on further short excerpts from the NATO papers. The authors strongly encourage interested readers to consult the original source material.

Researchers confirmed by several methods that the equatorial variety of spread F is the result of the scattering of the exploring radio wave transmitted by the ionosonde. Further, they determined that this scattering was caused by field aligned irregularities. The elongation of these irregularities is rather large and their long axis is aligned with the planetary magnetic field. The axial ratio of the elongation of the irregularities has been variously reported from 7:1 to 100:1. [2] This finding of irregularities and their causal relationship to equatorial spread F is not in question at this point.

Researchers at the NATO AGARD Conference also discussed the causal mechanism of spread F at mid-latitudes:

"The mechanism suggested for temperate latitude type spread F by (several researchers) is similar to that postulated by (others) for Arctic spread F. They suggest that the irregularities in electron density may form "ducts" or "wells" in the F region aligned with the magnetic field. At frequencies near to the critical frequency the direction of the wave normal at one point in the path of the wave may become parallel to the direction of the field. Under these conditions the wave could enter the duct, which would act as a wave-guide.....The wave would be reflected from the end of the wave-guide, and retrace its path to the ionosonde.

Although this theory...appears to be capable of explaining the characteristics of temperate latitude type spread F, it is difficult to test experimentally...MULDREW [5] HAS ANALYZED THE PROPAGATION OF A WAVE IN AN IONOSPHERE CONTAINING FIELD ALIGNED SHEETS OF IONIZATION RATHER THAN DUCTS OR WELLS. HE HAS SHOWN THAT DUCTING OF THE WAVE ALONG THE SURFACE OF THE SHEET CAN OCCUR, AND THIS MIGHT PROVIDE AN ALTERNATIVE, ALTHOUGH SIMILAR EXPLANATION TO...(THE DUCTING THEORY)." [2]

ONSET OF SPREAD F

"The rapid rise in h'F which precedes the rapid onset of spread F is remarkably striking. In order to stress the behavior at this time we have constructed a schematic diagram showing a cross section of electron density vs. height and time over the interesting period. This is shown in Figure D-7i.

It is important to stress that for the sake of clarity the vertical scale in this diagram is magnified by a factor of 10. Figure D-7ii shows the correct scaling.

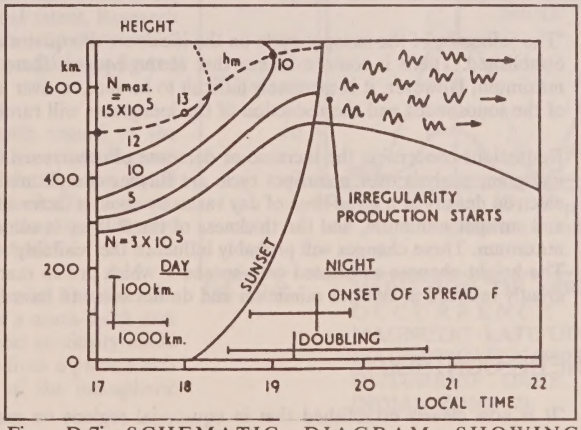

Fig. D-7i: SCHEMATIC DIAGRAM SHOWING ELECTRON DENSITY VARIATIONS IN THE F REGION PRIOR TO SPREAD F ONSET, IBADAN 1957-58

The data for this diagram are taken from a sunspot maximum period. True height values of electron density cannot be given after the onset of spread F due to its own effects on measurements. The time of final sunset at each height is marked by the sunset time. The mean time at which spread echoes are firmly established is also shown." [2]

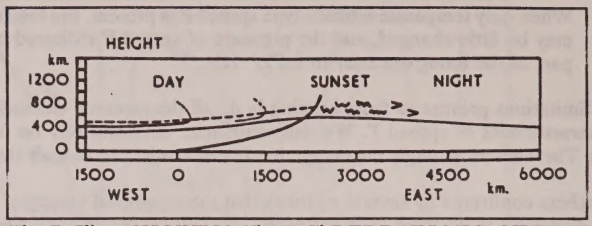

Fig. D-7ii: SHOWING Fig. D-7i REDRAWN TO GIVE AN EAST-WEST CROSS-SECTION OF ELECTRON DENSITY WITH EQUAL HORIZONTAL & VERTICAL SCALES

We must note that the researchers stressed repeatedly the gaps in their knowledge. They were particularly unsure about the mechanisms of production of these irregularities and what specifically determines their individual life cycle.

"...Observations by Kent (private communication) may throw some light on the initial stages of spread F development. Using an East-West split-beam aerial capable of observing either eastward or westward he was able to watch the appearance of satellite (echoes) and to establish some directional information. It seems that the satellite echoes first appear mainly in the East. Kent's experiment was able to observe the commencement of spread F first in the East and then in the West, in fact, to follow the "front" of spread F across the ionosphere from East to West and to observe that at least on occasions it moved with a speed close to that of the sunset line 1500 km/hr. It would appear most improbable that the irregularity causing a satellite should itself move ahead of the sunset line, as the velocity involved is much higher than those normally associated with ionospheric irregularities; indeed, Kent's results provide some evidence that the satellites move from West to East at about the same velocity as spread F irregularities. Many more detailed experiments of this nature are required to examine this early critical period of the incidence of spread F." [2]

SUNSPOT CYCLE EFFECTS

"The influence of the sunspot cycle on the incidence of equatorial spread F is not at all clearly established. There is some evidence that at the equator there is more spread F at sunspot maximum. However, it is extremely difficult to be sure, as over a period of years the constancy of the ionosondes and the reduction of the ionograms will rarely remain the same.

Deductions concerning the increase or decrease of occurrence of irregularities made from an ionogram analysis over a sunspot cycle are further complicated, since the average maximum electron density at a given time of day varies by about a factor of 4 between sunspot maximum and sunspot minimum, and the thickness of the F layer is some 30% greater during sunspot maximum. These changes will probably influence the "visibility" of a given size of irregularity... The height changes associated with spread F which are so marked at sunspot maximum are greatly reduced at sunspot minimum and do not seem to have been fully analyzed." [2]

MAGNETIC CONTROL

"It is now clearly established that in equatorial regions on magnetically disturbed days the occurrence of spread F is reduced. The equatorial belt where this is true is quite closely coincident with the equatorial spread F belt and also the belt in which the F layer has a large height increase around sunset. In fact on the disturbed days the sunset rise is considerably reduced. This is added evidence for the association of the occurrence of spread F with the rise. It would seem that the occurrence of magnetically disturbed conditions lead to electrodynamic forces on the equatorial F layer which oppose the normal vertical movements. It is possible that some of this effect could be due to a temperature increase resulting from the disturbed

magnetic conditions.

The magnetic control is much more marked at sunspot maximum than it is at sunspot minimum. It is also much less marked during local summer conditions. In fact at sunspot minimum local summer the influence of the magnetic disturbance may even be reversed." [2]

The data portrayed in Figure D-8 was derived at sunspot maximum and clearly illustrates the relationship between equatorial spread F and the magnetic equator. It also shows that far more spread F occurs during quiet magnetic conditions than disturbed conditions, except during northern summer.

Note also that there is an increase in spread F at the northern polar latitudes during disturbed days at the Equinox. During the winter, both curves show a rapid increase above 40 degrees N. latitude. Of potential interest as it might relate to trans-polar Asian DX, those curves which rise in the northern high latitudes are not replicated in the case of the southern hemisphere. Subject to the one exception noted above, however, all equatorial spread F appears to occur between 30 degrees N. and 30 degrees S. latitude.

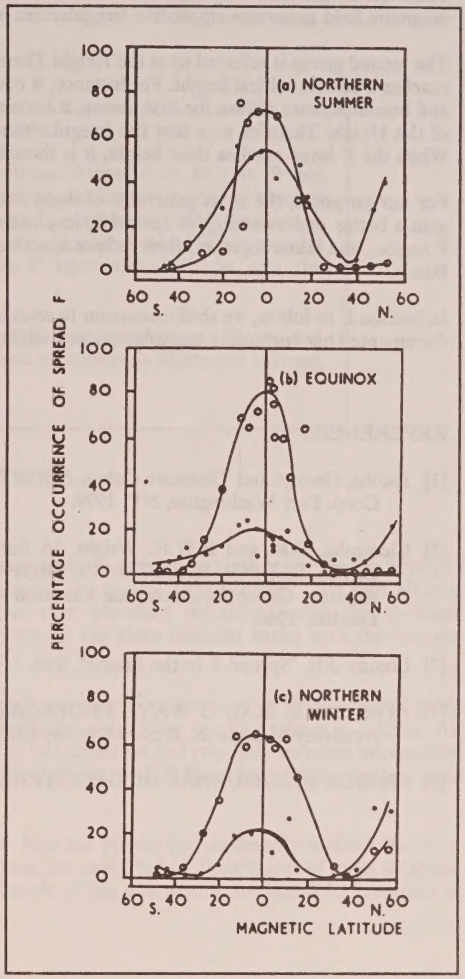

Fig. D-8: VARIATION OF SPREAD F OCCURRENCE WITH MAGNETIC LATITUDE FOR MAGNETICALLY QUIET AND DISTURBED DAYS, AFRO-INDIAN ZONE [2]

MACRO-STRUCTURE OF SPREAD F

There is considerable evidence that the irregularities which give rise to spread F occur in patches, rather than as a continuous distribution. There have also been a number of studies of the sizes of these patches of irregularities and the results appear to correlate fairly well when one considers the variety of techniques and frequencies used in obtaining them.

Studies of the maximum size of patches found them to be, on average, 300 to 400 km in horizontal extent. Research results from several projects to measure the thickness of patches were very mixed, with maximum thickness figures varying from 10 to 150 km.

Only two results were discussed with regard to the lifetime of patches of irregularities. One research group considered that the patches, once produced, often would last throughout the night while they travelled from west to east. The other researchers found that they could observe a single patch for a mean time of 20 minutes.

These two results are difficult to reconcile. The short 20-minute lifetime could be the result of a north-south drift of the patches, as the north-south aspect sensitivity would prevent direct back-scatter occurring from a patch which had drifted to the north or south of the ionospheric station.

The velocities of patch drift of the irregularities did co-relate very well in the various studies, averaging about 100 meters per second. This converts to 360 km per hour.

A thorough compilation of research results in this area is contained in our source reference. [2]

SUMMARY

A number of theories have been advanced since the 1930's for the production of the irregularities responsible for spread F. These tend to be grouped into two broad categories. The first can be called the Vertical Drift Theories. In general, they hold that the movement of the F layer vertically across the essentially horizontal magnetic field generates ripple-like irregularities in the layer. [2]

The second group is referred to as the Height Theories which postulate that something happens when the F layer reaches a certain critical height. For instance, it could be possible that when the F layer reaches a certain height and becomes more diffuse for that reason, it becomes electromagnetically unstable and sort of curdles! Another of the Height Theories says that the irregularities are always there as sort of whirlpools in the topside layer. When the F layer reaches their height, it is thought to conform to the already existing areas of instability. [2]

For our purposes, the exact generator of these irregularities may not be relevant. What is important is that we gain a better understanding of spread F, its close relationship with diurnal changes in the virtual height of the F region, and taken together, their influence on weak signal propagation at planetary distances on the Tropical Bands.

In Section E to follow, we shall endeavour to co-relate these geophysical characteristics of the F layer to the well-documented but heretofore unexplained "seasonality" that experienced DXers have noted on the Tropical Bands.

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[4] Al'pert, Ya.L. RADIO WAVE PROPAGATION AND THE IONOSPHERE [Russian text, USSR Academy of Sciences Press, Moscow, 1960]. Translated by CBE, Inc., New York, 1963.

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SECTION E

SPECULATION ON THE GEOPHYSICAL FOUNDATION OF SEASONAL TROPICAL BAND DXING...A THEORY FOR ALL SEASONS

ABSTRACT -

The reception conundra and seasonal patterns discussed in Section B are revisited and explained based on the authors' supposition that a peaked band of refractive or conductive enhancement, statistically centred on 9 PM, develops in the Tropics. The principal geophysical activities characteristic of the equatorial ionosphere at that time are the peak in F layer virtual height and the concentration of spread F activity.

The apparent linkage between the location of the equatorial spread F zone and seasonal dawn enhancement in North America is extensively illustrated utilizing the DX Edge.

INTRODUCTION

The recognition of true seasons in Tropical Band DXing is not entirely new for the authors or for the hobby in general. However, there has been an absence of discussion about the causes of "seasonality". We have all long recognized that Tropical Band frequencies only propagate over planetary distances across the darkness hemisphere. We have also recognized that the area of darkness at any given moment varies with the seasons. Until recently, it seemed that our knowledge stopped there.

However, in recent years the DXing hobby has been undergoing a quiet revolution as we have acquired more sophisticated analytical tools. The 'DX Edge' has been available and widely used for about a decade. An inexpensive slide-rule-like world map device, it gives the DXer instantaneous and relatively accurate information on the current areas of daylight and darkness of the planet. We shall use the DX Edge as an illustrative tool later in this Section.

John Devoldere's 'Low Band DXing' software introduced in 1986 has proven extraordinarily useful to many of us because it provides daily sunrise and sunset times throughout the world and plots daily lists of other locations positioned on the same grayline as that of the DXer. An example of this was used in Section B for purposes of addressing the "width" of the grayline.

SEASONAL PATTERNS

But soon after beginning to use the graylining software, the authors also became more acutely aware that the presumed predictability of grayline reception did not necessarily fit with what seemed to be a specific "season" of DXing peculiar to portions of Asia and the Pacific during early mornings in North America. As introduced in Section B, we noted that these seasons were largely INDEPENDENT of where a DXer was located in North America.

This was first observed in relation to Javan and Sumateran stations which seem to "peak" near the Equinox. Another season well-known to many experienced Tropical Band DXers is the Sub-continental season which is centred on the Winter Solstice and consistently exhibits an annual duration of about six weeks. These seasons are predictable, virtually irrespective of the DXer's location in North America.

Finally, it seems that the season for Papua New Guinea stations is the three months centred on Summer Solstice, although in the East the signals are frequently masked by seasonally high QRN originating further to the west of dawn at the receiver. An exception to this seasonal pattern might be the West Coast, which hears the Papuans at the PNG sunset extraordinarily well throughout the year.

DIURNAL ANOMALIES

Some serious thinking about these seasonal patterns which were largely independent of receiving location led to a strong conviction that the "seasons" must be governed by what was occurring in the region of the TRANSMITTER, rather than at the receiver. The supposition was that this must be something very different from, although probably complementary to the various "partial darkness" enhancement possibilities that have addressed.

At first, we suspected that true graylining to Eastern North America plus sunset-at-the-transmitter enhancement, more noticeable for Central and West Coast locations, would explain the seasons of dawn Tropical Band DXing. They do not! As we first noted in Section B, the times are wrong in many cases.

Then we began to notice that often the timing of our DX catches did not co-incide with sunset at the transmitter; rather, best levels co-incided with 8 PM to 10 PM local time AT THE TRANSMITTER. We were puzzled by this seeming paradox until we put it together with the other two apparently anomalous experiences mentioned near the end of Section B. They were:

The experience of John Bryant and others DXing from Hawaii and from the West Coast of North America: some noted that signals to their west (for example, Solomons and PNG) would reach a peak at transmitter sunset, drop slightly, then climb in strength for about three hours. Thereafter, the signal strength would start a long, slow slide to near inaudibility prior to dawn at the receiver. (In DXer's parlance, "the path seemed to wear out"!)

Figure E-1 illustrates the propagation path "wearing out" between a receiver in Hawaii and transmitter in the Solomons and PNG. As can be seen, during the early part of the reception period (before midnight in Hawaii), the area of equatorial spread F blankets the entire signal path. Six hours later, near Hawaiian dawn, the entire area of spread F has cleared out of the path.

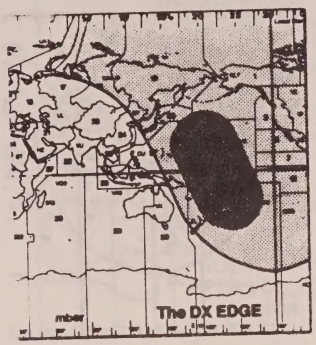
Finally, the experience of DXers in the Eastern and the Central Time Zones, sometimes on the West Coast too at mid-winter: hearing signals on an east-west path from Central Africa at excellent levels at 2200-2300 sign-off (early evening in the Central U.S.) and finding the same stations five to six hours later being MUCH weaker at their sign-on (near dawn in Central Africa) on the same path, the same local day at the receiver.

Figure E-2 illustrates the position of the equatorial spread F zone in mid-winter and at the Equinox, at dusk in Central North America. Notice that in mid-winter, the area of spread F is perfectly positioned between the receiver and stations in West-Central Africa. The spread F area has cleared the path completely five hours later when some of the Africans are signing on.

Three months later at the Equinox, the spread F zone is no longer ideally positioned for early evening Africans that might still be on the air at dusk at the receiver. Note however the superb positioning for reception of Latins throughout the evening.

(Please refer to Figure E-1 and Figure E-2 on following pages)

15 DEC 0830 UTC
(HAWAII: 10:30 pm)



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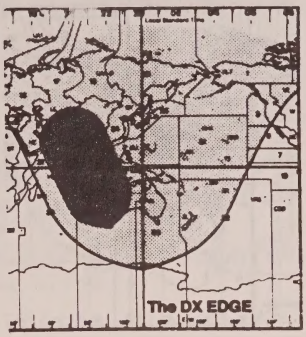

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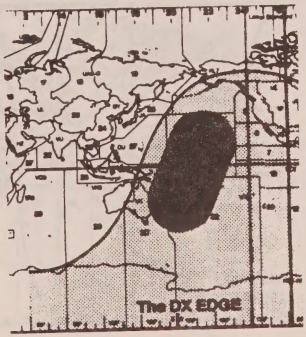
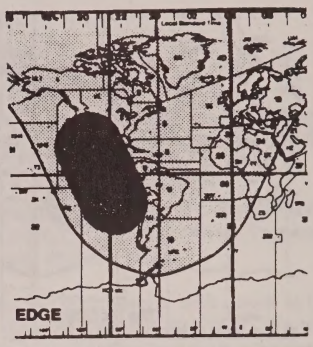


15 JUNE 1500 UTC
(HAWAII: 5 am)

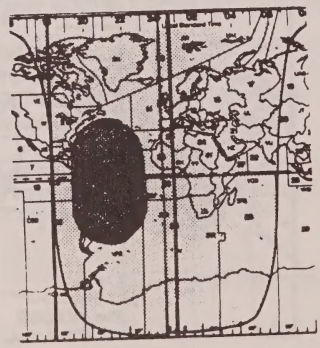
Fig. E-1: MIGRATION OF EQUATORIAL SPREAD F COVERAGE FOR THE HAWAII TO SOLOMON ISLANDS/PAPUA NEW GUINEA PATH

15 DEC 2300 UTC

15 DEC 0400 UTC



15 MAR 0030 UTC



15 MAR 0400 UTC

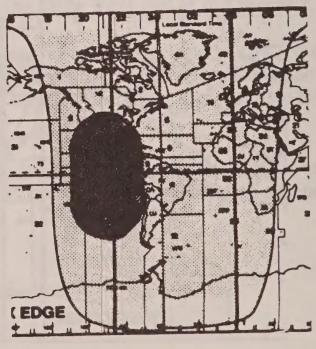


Fig. E-2: EVENING POSITIONING OF SPREAD F ZONE AT MID-WINTER AND EQUINOX FOR RECEIVER IN CENTRAL NORTH AMERICA

THE SPREAD F FACTOR

Now, let's take another look at some of our spread F findings, with commentary appropriate to this Section. Figures E-3 through E-7 are repeated from Section D.

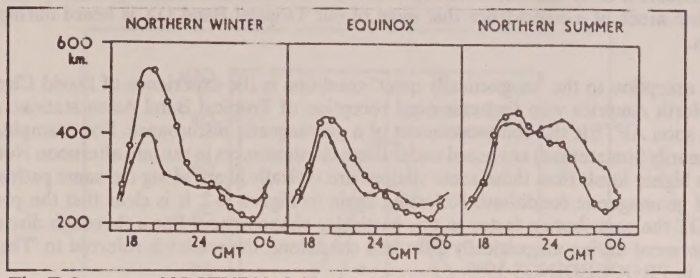


Fig. E-3: NOCTURNAL VARIATION OF VIRTUAL HEIGHT OF F LAYER (Ibadan, Nigeria, 1957-58)

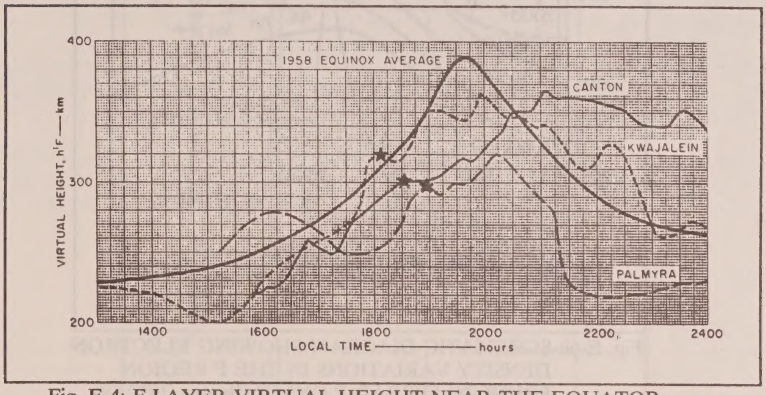


Fig. E-4: F LAYER VIRTUAL HEIGHT NEAR THE EQUATOR

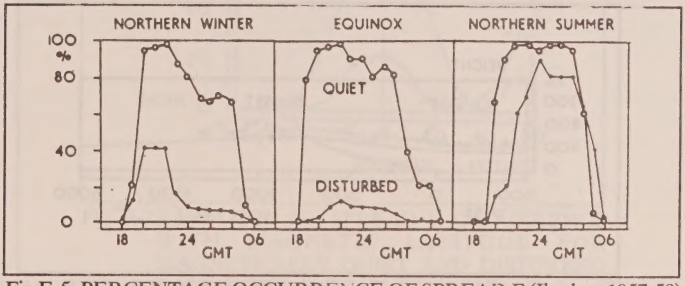


Fig E-5: PERCENTAGE OCCURRENCE OF SPREAD F (Ibadan, 1957-58)

These and other studies confirm the rapid rise of the virtual height of the F layer and are our first indication of a phenomenon spanning the equatorial latitudes during the local tropical evening, conveniently centred around 9 PM local time.

Figure E-5 renders a clear indication that spread F is the NORM during magnetically quiet tropical evenings. It is almost too much of a coincidence that most of our Tropical Band DX is heard during or near the end of quiet periods.

The notable exception to the "magnetically quiet" condition is the experience of David Clark and other DXers in Eastern North America who find enhanced reception of Tropical Band Asian stations across the northern polar region soon AFTER the commencement of a geomagnetic disturbance. For example, certain Indonesian stations (primarily Sumaterans) are heard under these circumstances in the late afternoon North American winter at very much higher levels than those same stations are typically heard along the same path at "maximum dawn", regardless of geomagnetic conditions. Referring again to Figure E-2, it is clear that the position of the spread F zone is NOT the contributing factor to this particular phenomenon. For a thorough discussion of trans-polar signal enhancement during magnetically disturbed conditions, the reader is referred to 'The Auroral Factor' by David Clark in PROCEEDINGS 1989.

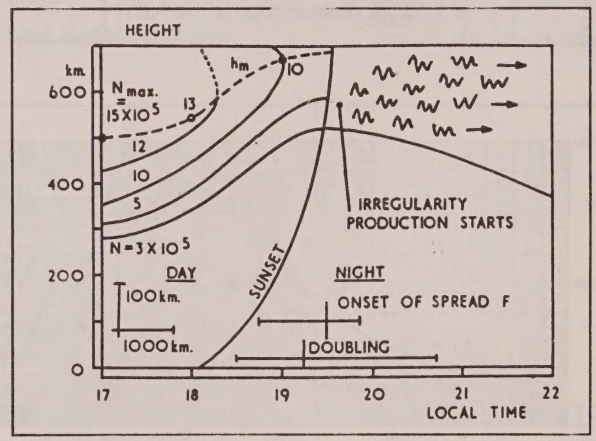


Fig. E-6i: SCHEMATIC DIAGRAM SHOWING ELECTRON DENSITY VARIATIONS IN THE F REGION PRIOR TO SPREAD F ONSET (Ibadan, 1957-58)

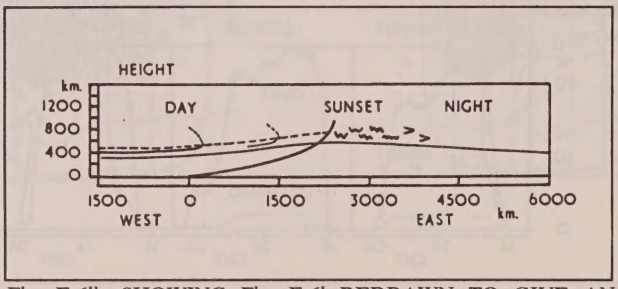


Fig. E-6ii: SHOWING Fig. E-6i REDRAWN TO GIVE AN EAST-WEST CROSS-SECTION OF ELECTRON DENSITY WITH EQUAL HORIZONTAL AND VERTICAL SCALES

The preceding two illustrations are the most important to us, personally, in our interpretation of spread F and its seeming co-relation to optimal Tropical Band DX propagation. Local time is shown the horizontal axis. If we assume that the raised level of the ionosphere and the strengthened refractive capabilities of the irregularities are real properties of the ionosphere, this may be the mechanism which explains many formerly puzzling but most definitely real-world DX experiences.

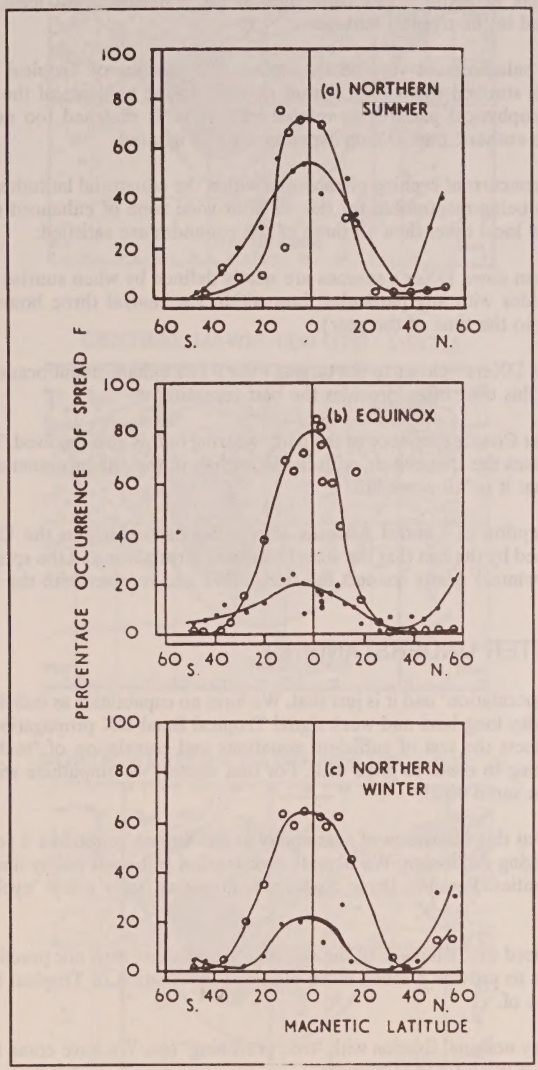


Fig E-7:VARIATION OF SPREAD F OCCURRENCE WITH MAGNETIC LATITUDE FOR MAGNETICALLY QUIET AND DISTURBED DAYS (Afro-Indian Zone)

E-7 further confirms the strong relationship of magnetically quiet conditions with spread F and defines the main location of the phenomenon in the Tropics.

PUTTING IT ALL TOGETHER

After much discussion, the authors could find only one premise that seemed to account for all three of the diurnal anomalies which were cited: THERE MUST BE A BAND OF ENHANCED PROPAGATION, ABOUT SIX HOURS WIDE, FALLING IMMEDIATELY BEHIND THE SUNSET TERMINATOR. Further, this enhancement must peak at about 9 PM local time at the transmitter. At least, this must be the case for transmitter sites located in the tropical latitudes.

This peaked band of enhancement very neatly explains the seasons of Tropical Band DX discussed above. Actually, we were both stunned when John Bryant delved into the contents of the NATO book on the spread F phenomena. The geophysical patterns as related in Section D matched too neatly with the three diurnal conundra and with the authors' own DXing experience to be ignored.

Now, if we accept the concurrent evening phenomena within the equatorial latitudes - a rapid rise of h'F and the onset of spread F - as being responsible for this six hour-wide zone of enhanced reception, with both criteria peaking at about 9 PM local time, then all three of the conundra are satisfied:

1. The North American dawn DXer's seasons are neatly defined by when sunrise in the eastern two-thirds of the country co-incides with any particular time within the central three hours of the enhancement zone (varying according to the time of the year).

   For the West Coast DXers - closer to the targets - the 9 PM enhancement occurs before local dawn in many cases but even so, this time often provides the best reception.

2. The Hawaiian/West Coast experience of the path "wearing out" is also resolved. The peak signal occurs when the 9 PM mark passes the transmitter, with the latter half of the enhancement zone falling between Hawaii and PNG. After that it is "all down hill."

3. The enhanced reception of Central Africans after dusk, particularly in the Central Time zone of North America, is explained by the fact that the steeply inclined terminator and the spread F zone (positioned from NW to SE at mid-winter) neatly connect the transmitter and receiver with the full band of enhancement.

TOWARDS A BETTER UNDERSTANDING

This Section is titled "speculation" and it is just that. We have no capabilities as individuals to test our convictions as they relate to everyday long haul and weak signal Tropical Band DX propagation, much less translate them into a theory which meets the test of sufficient equations and correlation of "real" data with the geophysical factors we are attempting to come to grips with. For that matter, we empathize with Mr. Blanarovich - surely he found himself in the same boat!

We hope and expect that this discussion of seasonality and DXing in general as it relates to spread F will spark thorough and wide-ranging discussion. We hope that discussion will cross hobby lines to the radio amateur and medium wave communities. Possibly, these discussions may even raise a few "eyebrows" in the scientific and professional world.

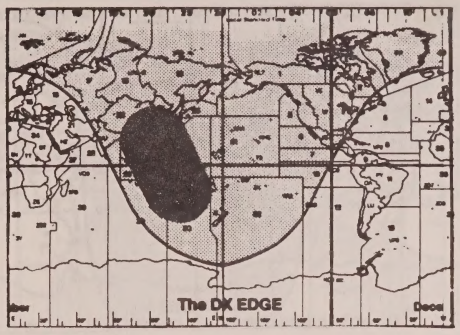
The authors are convinced that a linkage of the spread F phenomena with our practical, real-life DX experience over many years seems to provide a much more plausible explanation of Tropical Band DX propagation than any other we are aware of.

We have abandoned any notional fixation with "true graylining" too. We have come to believe that "9 PM at the transmitter" is the real 'SWEET SPOT'.

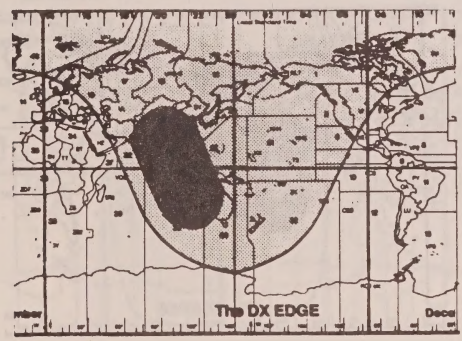
The following diagrams are worthy of careful study by serious DXers. Utilizing the DX Edge as the authors did, it is not difficult to replicate these illustrations for any receiving location. The criteria for plotting the location of the spread F zone are simply local time between 7 and 11 PM in the equatorial latitudes between 25 degrees N. and 25 degrees S.

In so-doing, the authors invite interested readers to consider the following question: can it be that the seasonality of Tropical Band DX in North America is ultimately associated with the spread F phenomenon, where 9 PM at the transmitter co-incides with dawn at the receiver?

EASTERN DAWN: 1230 UTC - DEC 15



CENTRAL DAWN: 1330 UTC - DEC 15



NORTH-WESTERN DAWN: 1600 UTC - DEC 15

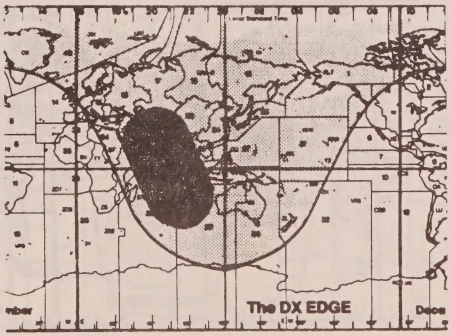
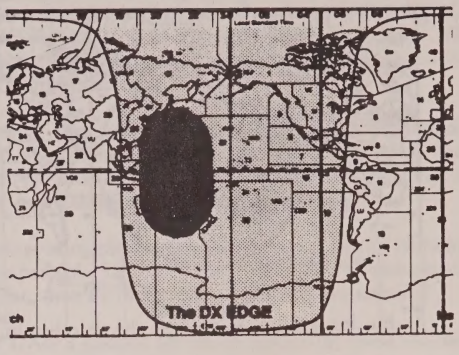
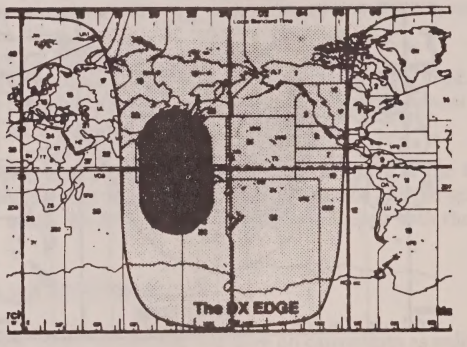


Fig. E-8: SPREAD F AND THE SEASONALITY OF DAWN ENHANCEMENT IN NORTH AMERICA - THE SUB-CONTINENT SEASON

EASTERN DAWN: 1130 UTC - MAR 15



CENTRAL DAWN: 1300 UTC - MAR 15



WESTERN DAWN: 1430 UTC - MAR 15

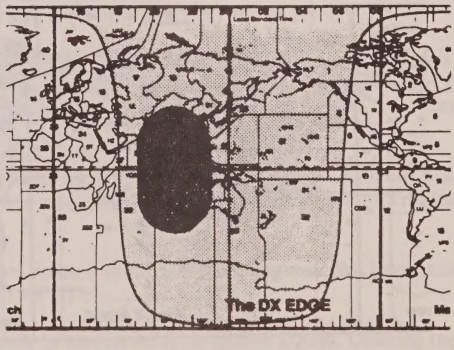
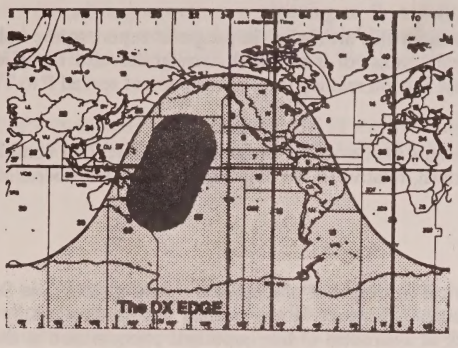
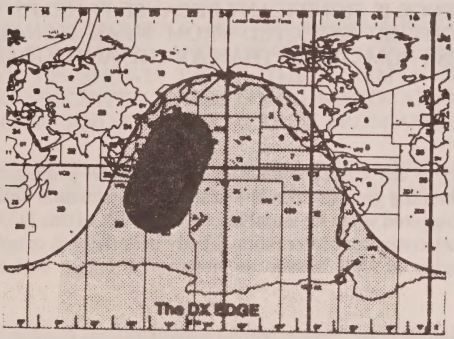


Fig E-9: SPREAD F AND THE SEASONALITY OF DAWN ENHANCEMENT IN NORTH AMERICA - THE SUMATERA/JAWA SEASON

EASTERN DAWN: 0930 UTC - JUNE 15



CENTRAL DAWN: 1100 UTC - JUNE 15



NORTH-WESTERN DAWN: 1200 UTC - JUNE 15

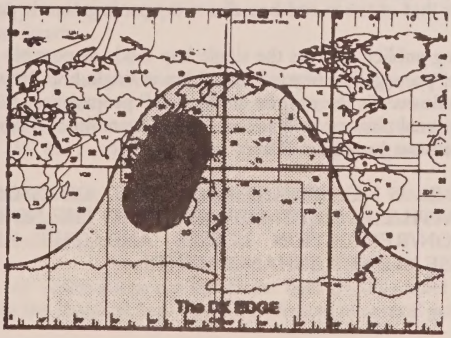


Fig. E-10: SPREAD F AND THE SEASONALITY OF DAWN ENHANCEMENT IN NORTH AMERICA - THE PNG SEASON

AFTERWORD

As our title implies, we consider this article an "in progress" report to the hobby. While sections of the article are undoubtedly controversial, most of it is actually straightforward reporting of well-established aspects of physical reality. Only the last Section relating the phenomenon of spread F to Tropical Band seasonality is purely speculative.

So, while this is acknowledged to be an "in progress" work, we feel confident that some observations and conclusions can now be drawn, relative to the major geophysical considerations we have studied:

1. Spherical Convergence:

The phenomenon of spherical convergence of long-haul signals discussed in Section A and elsewhere is almost totally new to hobby discussion. However, it was publicly accepted as fact by the ITU/CCIR in 1978! We are at a loss to explain the lack of awareness of this important phenomenon in the radio hobbies. Please note that this phenomenon is only loosely connected to "antipodal focusing." Also note that spherical convergence has an amplifying effect on ALL signals which travel more than 6,250 miles to reach your antenna.

SPHERICAL CONVERGENCE IS SIGNIFICANT BECAUSE IT HELPS TO ACCOUNT FOR BETTER RECEPTION THAN MIGHT BE EXPECTED FROM WEAK SIGNAL TROPICAL BAND DX AT PLANETARY DISTANCES FROM OTHER THAN AT THE ANTIPODAL POINT.

2. Single Hop Model:

The acceptance by the ITU of the concept that true long-haul HF propagation beyond 10,000 km happens NORMALLY without intervening ground hops is a startling fundamental shift in the theoretical basis of HF communication! We were staggered when we stumbled upon records of this ITU action taken fourteen years ago. When this action by the most competent international body in its field is coupled with other research findings, the weight of evidence begins to shift heavily in favour of a single hop model for ALL high frequency communication.

D.B. Muldrew of the Canadian Defense Research Telecommunications Establishment is the acknowledged father of conventional "ray tracing" techniques. These are the techniques used by authorities to model all forms of radio propagation. As early as 1959, he published a rigorous application of ray tracing: "The method was applied to an oblique path between Ottawa and Slough, U.K. (5,300 km) to determine certain properties of the one-hop mode. From this it is shown that at times one-hop direct ray propagation is possible over this path." [1]

If the authority on ray tracing publicly accepts the single hop mode as possible at 5,300 km, and the ITU states that the NORMAL mode of propagation beyond 10,000 km is single hop, we wonder what DIRECT evidence exists that the multi-hop mode ever is the normal mode of HF propagation at any distance. We are coming to believe that very little, if any, real physical evidence exists for the multi-hop mode, at least within the frequency spectrum that concerns shortwave broadcast DXers.

THE SINGLE HOP MODEL IS SIGNIFICANT BECAUSE IT DISASSOCIATES ITSELF FROM THE PROBLEMS WE HAVE WITH THE MULTI-HOP MODEL AS THE NORM, SUCH AS THE ISSUE OF MULTIPLE REFRACTION/REFLECTION LOSSES AND THE ABSENCE OF MULTIPATH DISTORTION AT SUNRISE/SUNSET ENHANCEMENTS.

3. Conduction:

The deeper that we have gone into recent published scientific research, the more admiration we gain for the work of amateur radio operator Yuri Blanarovich. Please note that his article was first published by CQ Magazine in 1980. It is true that some research was published in the 1960's and 1970's which pointed the way to new understandings of radio wave propagation in the ionosphere. However, the majority of the experimentation and publication of research which supports IONOSPHERIC CONDUCTION as the primary mode of long haul propagation has been published in the 1980's. At the very least, Blanarovich's work affords us another slant on

thinking about "refraction", making a clear distinction, as it does, from the concept of reflection. We feel that Mr. Blanarovich's insights will someday be considered quite visionary.

It is interesting to note that the Canadian government is planning to fly a major satellite aboard the Space Shuttle in 1992 for the expressed purpose of making detailed "topside" investigations of the ionosphere AS IT RELATES TO HIGH FREQUENCY RADIO PROPAGATION. We think the message here is that there is still much to be learned!

THE CONDUCTION CONCEPT IS SIGNIFICANT BECAUSE IT COMPLEMENTS THE SINGLE HOP MODEL, TAKING INTO ACCOUNT IONOSPHERIC LAYERED SHEETS, SIGNAL DUCTING AND TILT ZONE MECHANICS AT SUNRISE/SUNSET.

4. Spread F:

The connection between the well-documented phenomena associated with spread F and the seasonal characteristics of Tropical Band propagation is, at this point, classed as speculation. However, we feel that the weight of evidence is almost overwhelming. The seasonal characteristics of Tropical Band DXing, at least from North America, have been proven by the daily experiences of three generations of DXers. This seasonality is not readily explained by current theoretical models of shortwave propagation. Neither are the three conundra (mysteries) discussed in this article explainable by the currently accepted models of HF propagation.

TROPICAL ZONE SPREAD F PHENOMENA ARE SIGNIFICANT BECAUSE IN TERMS OF TIME HORIZON, GEOGRAPHIC LOCATION AND GENERAL CONSISTENCY WITH MAGNETIC CONDITIONS, THEY CAN BE SHOWN TO BE THE COMMON DENOMINATOR, AT THE TRANSMITTER, WHICH IS ASSOCIATED WITH OPTIMAL NORTH AMERICAN DAWN RECEPTION FROM ASIA AND THE PACIFIC, AND POSSIBLY AT DUSK FROM AFRICA AND LATIN AMERICA.

FIELD ALIGNED IRREGULARITIES MAY ENHANCE THE REFRACTORY (CONDUCTION) PROCESS AND OPTIMALLY "PROJECT" CERTAIN RAY PATHS IN ACCORDANCE WITH THE LONG HAUL SINGLE HOP MODEL.

SUMMING IT UP:

We do NOT contend that our observations and those of others whom we have cited meet the level of rigor that one might expect to find if we were proposing a new "theory" in the classical sense.

We DO contend, however, that the results of our study to this point raise serious doubts about the fundamental validity of commonly accepted "theoretical models" as they relate to multi-hop propagation and sunrise/sunset enhancements on the Tropical Bands.

Furthermore, we DO contend that our observations meet the "simplicity test" of the Scientific Method. This test holds that where multiple explanations of an observed physical phenomenon exist, the MOST SIMPLE explanation is usually closest to the truth. Neither the three conundra discussed in this article nor the consistent seasonality of Tropical Band DX are readily explained by current propagation models.

Both a conduction-based model of sunrise/sunset enhancements and a direct linkage between spread F and Tropical Band seasonality are elegantly simple explanations of phenomena which conventional models fail to satisfy, even by the most tortured means.

Finally, we DO contend that our observations are significant because they meet the ultimate test of simplicity: they are entirely consistent with the practical, real-world experiences of several generations of dedicated Tropical Band DXers.

WHERE DO WE GO FROM HERE?

The authors are very grateful to have been at the "right place at the right time" to have made this contribution to what we hope will be collective discussion among interested groups. We acknowledge that we probably have raised more questions and issues than we have resolved.

Both of us are primarily dawn-oriented DXers of trans-polar and trans-Pacific targets. We have some indication from the review process of PROCEEDINGS 1990 that North American evening DXers of African and Latin American targets recognize a similar connection between their Tropical Band seasonality and that discussed here. What do you think?

Some members of both the professional and hobby communities will find the classical models of multi-hop model of HF propagation and sunrise/sunset enhancements impossible to abandon, no matter what the ITU says or some research data indicates. We invite rebuttal. We do urge, however, that PRIMARY research data be cited. As we all know now, just because the ARRL Handbook (or the ITU Green Book) says, "it's so" is no proof at all!

We would welcome articles, in **fine tuning's** PROCEEDINGS 1991 or elsewhere, from other geographic perspectives. Just as we experience "seasons" in North America, we suspect that DXers in Europe, the Far East, Latin America, Down Under, etc., may be able to co-relate their seasonality patterns with tropical zone irregularities (spread F). Perhaps this will bring us to a closer understanding of the geophysical phenomena which surely influence reception patterns elsewhere in the world.

Finally, we see a great loss to us all from the almost impenetrable intellectual barriers between the various radio hobbies, and between the hobby and professional worlds. This must not continue. We think it's time for the classical theorists and the pragmatists who rely on their everyday experience to combine their energies.

We also suffer from artificial intellectual barriers between the frequency band-oriented areas of study. Yes, there are differences between propagation at UHF/VHF, at HF and at MW/LW. We believe, however, that both the professionals and hobbyists have concentrated far too long on those differences and should look more closely for commonalities. The professional community, particularly in the fields of terrestrial and astrophysics has started down this road. It is time for the hobby community to follow.

REFERENCE

[1] Muldrew, D.B. "An Ionospheric Ray-Tracing Technique and Its Application to a Problem in Long-Distance Radio Propagation". IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION. pp. 393-396; October, 1959.

antennas

T2FD - THE FORGOTTEN ANTENNA

Guy Atkins

If a survey were taken of all shortwave DXers to find the antennas they use, I suspect the majority would be found using the random wire. Next in popularity would likely be the commercially available sloper antennas and trap dipoles.

However, an antenna's popularity does not necessarily reflect excellent performance. While being simple and inexpensive to erect, the randomwire is susceptible to electrical noise, and presents a wide range of impedances to the receiver, depending on received frequency.

The terminated, tilted, folded dipole (T2FD) is a little known antenna that performs excellently. Compact in size compared to a half-wave dipole (approx. 67 feet long at 60 meters), the T2FD provides signal gain, wide frequency coverage, and exceptionally low noise characteristics.

An early discussion of the T2FD appeared in the June 1949 issue of QST, a popular magazine for radio amateurs. The author of this article continued his examination of the T2FD in the November 1951 QST as well as the February 1953 issue of the same magazine. A more recent article on the T2FD appeared in the May 1984 73 Magazine.

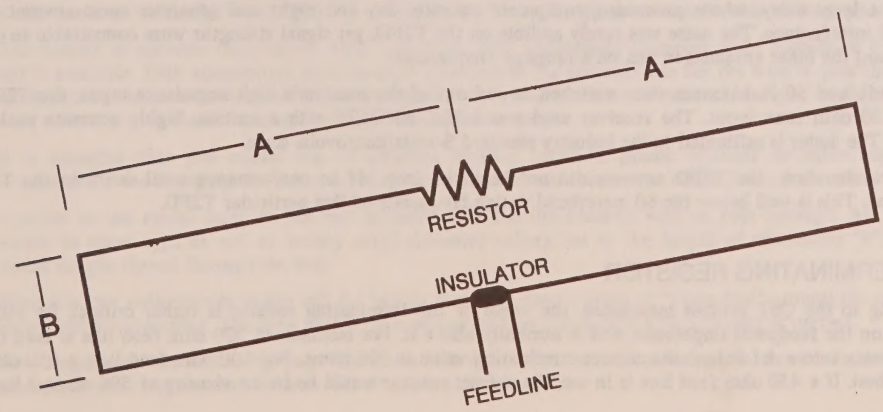
The World Radio Television Handbook for 1988 gave a brief description and diagram of the T2FD, and that year's WRTH Newsletter provided additional construction information. Further details were given in the 1989 WRTH. However, some misleading and incomplete information is given in these WRTH sources, which this article will later clarify.

DESIGN

Some have called the T2FD a "squashed rhombic" antenna. It does bear some design similarities to the non-resonant rhombic, but theoretically it is admittedly inferior. However, the T2FD performs well in a modest amount of space, while a rhombic antenna can be immense–virtually impractical–at all but the highest SWBC bands.

The T2FD is essentially a closed loop design with the element ends folded back and joined by a non-inductive resistor (see figure below). The feed line can be 300 to 600 ohm twinlead or open line.

Because twinlead and open line can be affected by nearby metallic objects (downspouts, metal window frames, etc.), a better feed line is coaxial cable connected to an impedance transformer (balun).



The T2FD has a characteristic 5 or 6 to 1 frequency ratio, which means that it works effectively from its low-end design frequency up to 5 or 6 times that frequency. For instance, the T2FD which I use is designed for optimum performance at 4.9 Mhz, but can operate up to the 25-29 Mhz range. In practice this antenna also works satisfactorily down to the 75 & 90 meter tropical bands, but not as well as a dipole or delta loop designed for 75 or 90 meters.

The formulas for calculating T2FD dimensions are as follows:

1. The length of each leg ("A") from the center is equal to 50,000 divided by the lowest desired operating frequency (in kHz) and then multiplied by 3.28. The answer is in feet.

2. The spacing between radiating wires ("B") is equal to 3000 divided by the lowest desired operating frequency (in kHz) and then multiplied by 3.28. The answer is in feet.

3. The sloping angle for a non-directional pattern should be on the order of 30°, but 20-40° is acceptable.

EXAMPLE: to design a T2FD for the center of the 90 meter band (3300 kHz) and up:

"A" = (50,000 / 3300) x 3.28 "B" = (3000 / 3300) x 3.28

"A" = 49.70 feet "B" = 2.98 feet

Total length of the antenna would be 99.4 feet (2 x 49.7), and the width would be 2.98 feet ("B").

The total wire used to complete the loop equals 204.76 feet (4 x 49.7) + (2 x 2.98).

PERFORMANCE

The United States Navy conducted extensive transmiting and receiving tests of a single T2FD antenna in the late 1940s at Long Beach, California. They employed a Model TCC Navy 1 Kw transmitter, with a frequency range from 2.0 to 18.0 Mhz. After a year of use on all frequencies, the T2FD was found to be superior to individual antennas on the various bands. The other antennas were removed from the Long Beach site after the tests.

Similar results during the same period were experienced by the Kyushu Electric Communications Bureau of Japan. Their experiments indicated that the terminated, tilted folded dipole was superior to the "zepp" and half-wave dipole types previously used. They noted wideband characteristics, and the T2FD gave a 4 to 8 dB signal increase at their various receiver sites.

My experience has shown the T2FD to be a fine performer when only a single shortwave receiving antenna can be erected, due to its wideband nature. It also has the advantage of electrical noise rejection (to a degree) compared to a random wire or even a dipole.

On the following page is a comparison of a 60 meterband T2FD, a 500 ft. longwire, and a 50 ft. random wire antenna. Tests were conducted at the home of Fred Carlisle, a DXer from rural Yelm, Washington. Nearby his home is a large dairy, whose processing equipment operates day and night and generates some amount of electrical interference. The noise was rarely audible on the T2FD, yet signal strengths were comparable to (or better than) the other antennas in use, on a range of frequencies:

The 500 ft. and 50 ft. antennas were switched in and out of the receiver's high impedance input; the T2FD fed the 50 ohm coax input. The receiver used was a JRC NRD525 with a custom, highly accurate analog S-meter. The meter is calibrated to the industry standard S-units/microvolts scale.

As the results show, the T2FD antenna did not begin to drop off in performance until down in the 120 meterband. This is well below the 60 meterband design frequency of this particular T2FD.

THE TERMINATING RESISTOR

According to the QST articles mentioned, the value of the terminating resistor is rather critical. Its value depends on the feedpoint impedance, and is normally above it. For instance, if 300 ohm feed line is used (or 75 ohm coax into a 4:1 balun) the correct termination value is 390 ohms. For 600 ohm feed line, a 650 ohm value is best. If a 450 ohm feed line is in use, the correct resistor would be in the vicinity of 500 ohms. I have

not discovered why the optimum terminating resistance is higher than the feedpoint impedance, nor do I know of a formula for calculating this relationship.

The terminating resistance becomes more critical as the feedpoint impedance is lowered. With lines of lower impedance (including a directly connected 50 ohm coaxial cable), the value is critical within about 5 ohms. (The QST articles did not state an exact recommended value when using a low impedance line.)

The WRTH editions give the erroneous impression that T2FD antennas REQUIRE a 500 ohm resistor and a 10:1 balun transformer, used with 50 ohm coax cable. This is not the case, although these values will work fine if you have the 10:1 balun available (normally hard to come by). A T2FD built with 75 ohm coax (RG-59 or RG-6), a common 4:1 balun, and a 390 ohm terminating resistor is recommended.

FREQ./STN.	T2FD(NW-SE)	50'(N-S)	500'(E-W)
17680 RNZ	S9	S8-S9 w/buzz	S9 w/buzz
17700 RM	S7-S8	S7 w/buzz	S7 w/buzz
17795 RA	S8	S6-S7 w/buzz	S7 w/buzz
15440 RBI	S6-S7	S6 w/loud buzz	S6 w/loud buzz
15435 BSKSA	S7-S8	S7 w/loud buzz	S7 w/loud buzz
15330 RAI	S5-S6	S5 w/loud buzz	S5-S6 w/loud buzz
12085 RD	S8-S9	S8-S9 slight noise	S8-S9 slight noise
11955 RJ	S9+10dB	S9	S9-S9+10dB
11940 RJ	S8	S9	S9
11505 RB	S4-S5	S4 moderate noise	S4-S5 slight noise
9895 RM	S9+10dB	S7	S9
9425 VoG	S6-S7	S5	S6
9375 RT	S8	S6 slight noise	S7 slight noise
7355 WYFR	S8-S9	S6-S7	S7
7335 CHU	S8-S9	S6	S7-S8
7255 VoN	S7-S8 slight noise	S5-S6 mod. noise	S6-S7 slight noise
6165 RN	S9+15dB	S9+10dB	S9
6150 RI	S7-S8	S7	S6
6135.4 RFO	S7-S8	S6 some noise	S6
5030 TBC	S5 slight noise	barely audible	S5 slight noise
5000 WWV	S9+10dB	S9+10dB	S9
4985 R.Bras.Cent.	S5	S5	S6
4915 Anhanguera	S4-S5	S5 noisy	S5 some noise
4885 O. del M.	S6	S6 slight noise	S6 slight noise
4865 L.V. de C.	S6	S6-S7	S5-S6
4765 RM	S7	S7 slight noise	S6-S7
3990 VOA Liberia	S4-S5	S5	S5
3975 BBC	S5	S5	S5
3330 CHU	S5 strong noise	S5 strong noise	S5 strong noise
3385 Rebelde	S5	S5 some noise	S6 some noise
2500 WWV	S6	S6-S7 some noise	S8
1610 TIS stn.	S5	barely audible	S8-S9

The resistor used MUST NOT be a wire-wound type; its inductance would affect performance to a substantial degree. A carbon resistor of 1/2 to 1 watt in size is perfect (for a receive-only T2FD). The WRTH Newsletter in 1988 said that the wire for a T2FD must be made of pure copper between 3mm and 5mm thick. In reality, the exact thickness and type of wire have very little bearing on the T2FDs performance for receiving. Your main consideration will be wire strength, regardless of diameter.

CONSTRUCTION TIPS

A T2FD takes more hardware to construct than a typical dipole. Maintaining a uniform spacing between the parallel wires, as well as sturdiness, are the primary considerations. My first attempt at a T2FD self-destructed when the antenna was hoisted into the air. I underestimated the strain the wires would be under. My current T2FD has been in use for over 1-1/2 years, and was built with 14 gauge stranded, cold-drawn copper wire.

The spacers or spreader bars can be fashioned from 5/8" (minimum) diameter wood dowels, or even acrylic rod if available. Drill appropriate sized holes at each end of the spreader bar for the wire to pass through. The spreaders should be secured to the wires so that they do not slide; one method is to "jumper" each spreader end with a short piece of stiff wire and solder to the antenna wire.

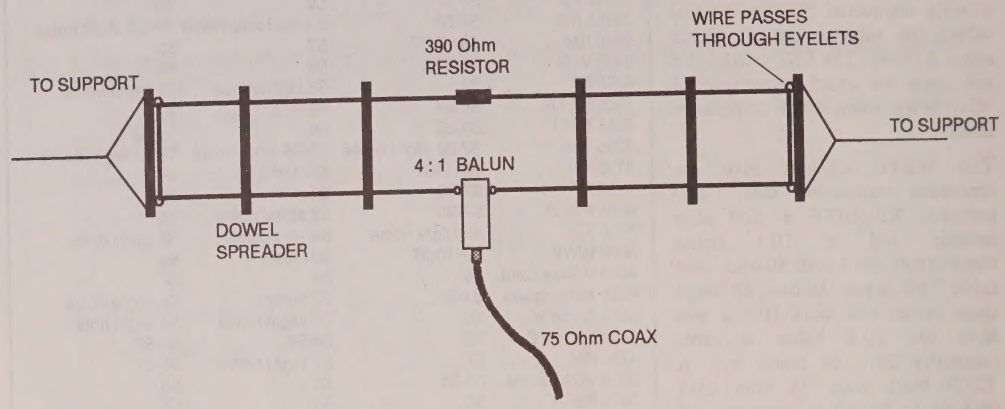
It is essential that you encase the terminating resistor inside a plastic cylinder or other support, and weatherproof the assembly. Be positive that the resistor will not receive the strain from the wires.

I prefer to use eyelet bolts on the end spreader bars for the antenna wire to pass through. An alternative would be some type of rod or strong, small diameter tubing cut to the length of dimension "B". The wire would simply thread through the rod.

Most amateur radio supply stores sell 4:1 baluns that only need a wrap of "Coax Seal" around the connections to be totally waterproof. The type with a coax connector that will accept a PL259 plug is perfect.

The diagram on the following page illustrates this type of construction, using the commonly available 4:1 balun, 390 ohm resistor, and 75 ohm RG-59 coaxial cable:

Typical construction details for T2FD.
Actual dimensions calculated per formulas on page A10.2.



Performance of the Terminated Folded Dipole, C.L. Countryman, QST, November 1951.

More on the T2FD, C.L. Countryman, QST, February 1953.

A Little Gem for QRP, 73 Magazine, May 1984.

World Radio Television Handbook, 1988 & 1989, Billboard Publications.

World Radio Television Handbook Newsletter, 1988.

SHORTWAVE DIRECTION FINDING: GETTING STARTED

Joe Farley Mitch Sams

If you told me five years ago that it would be possible to obtain an accurate DF bearing on Bhutan on 60 meters using a relatively small loop antenna indoors I might have suggested that you join the queue at the ticket window for the Disoriented Express. Of course, some fortuitous scheduling by the frequency management staff in Thimpu did not hurt, but this previously absurd feat has been accomplished by both authors. And, we hope, you may be able to do it also.

A loop possesses a number of desirable properties which taken together makes it an attractive candidate for serious DX work. A compact loop coupled with a suitable amplifier will exhibit sensitivity in its resonant bandwidth which will rival or exceed wire antennas occupying significantly greater real estate. A small loop tends to be quieter than a wire antenna of comparable output. These two factors taken together can give a decided edge to a loop in marginal reception conditions.

Most importantly, a small loop can exhibit enough directionality at shortwave frequencies to make it useful where controlled reception is desired . Attenuation of both local and distant sources of QRN is possible under many circumstances. This can offer the "edge" necessary to extract precious audio from a signal near the noise floor. Additionally, a small loop can provide enough discrimination to allow more than casual determination of the azimuthal bearing of a wave's arrival. This opens a lot of possibilities to the serious DXer, and Mitch will discuss this in a later section.

All of this does not come without a price, and the price may be substantial in terms of dollars, time, and effort. To get into this area, you will have to do a bit of homework and determine the most efficient design. Luckily, loops are flexible and forgiving. With a little research and experimentation you should be able to design and build one to suit your needs.

To do accurate DFing at shortwave with a loop, one must be able to make judgments on signal strength at various loop positions while working at or near the receiver noise floor. These loops will exhibit null depths of only 30 dB or so, and as such, an S-meter is virtually useless as a null detector in the presence of fading. The receiver noise floor and your ears are used to determine the null position, and an artificially high noise floor (due to local QRN) will limit the quality of signals you can hear. More importantly, this noise will severely limit your ability to make judgments. At this time, DF loops are being used by Mitch Sams, Guy Atkins, and myself. Only Mitch appears to be in an environment with local house noise low enough to allow the DFing of weak signals indoors on a steady basis. Guy and I are able to DF the more powerful stations, but this is very frustrating.

The following sections are intended to give you a better understanding of SW loops and the various tricks (DFing in particular) which are possible with them. I hope to also give you a better understanding of the obstacles you must overcome to be successful in your pursuit of this exciting technique. Rather than being a connect-the-dots approach to building a DF loop, I hope that this compendium of selected topics will better serve the majority of DXers. In the absence of comparable commercial offerings, you will undoubtedly be forced to "roll your own".

ABOUT DF LOOP CONSTRUCTION

A brief description of the loop which Mitch and I are using is now offered so that you may better visualize the following sections.

The loop and frame are similar to those described in [3]. The loop itself is an "air-core" winding and consists of 6 turns of 20 AWG insulated wire wound into an 18 inch square coil. Adjacent turns are separated by 1/2 inch. The loop is electrostatically balanced; the two ends of the loop connect to the inputs of a balanced FET amplifier, while the loop center-tap is at ground potential. The loop is supported on a conventional X-shaped wooden frame as detailed in [3]. This loop frame needs to be rigid. In practice, the nulls are extremely sharp, and sloppy frame construction could possibly decrease one's ability to determine nulls. Wood frame construction is the usual approach, but PVC frame construction should also work nicely.

The loop amplifier mounts to the lower frame arm with a patch of hook and loop fastener and cable ties. The wire length between the loop windings and the amplifier was kept to a practical minimum to eliminate stray pickup. This amplifier will be dealt with in greater detail in a later section.

The loop frame is mounted on a support arm which is (roughly) C-shaped. The upper end of this support arm is forked, and the lower arm of the loop frame is held in this fork by a bolt. This forms a pivot which allows the loop to be tilted in elevation. To the lower end of the support arm is attached a 1/2 inch steel shaft (about 10 inches long) which extends vertically downward. This shaft is the azimuthal pivot point of the loop and support arm.

An azimuth pointer was fashioned from a piece of acrylic sheet (scrap window glazing available at most hardware stores). It was scribed with a sharp knife, and was mounted on the bottom of the loop support arm so that the scribe line was perpendicular to the plane of the loop.

The base for the loop is fashioned as a small table. The table top is made from a 10 x 12 inch piece of 3/4 inch thick plywood. On this table is mounted an azimuth scale and also the loop control (tuning) box. The table is in turn bolted to a pedestal which is made from two 3 inch PVC closet flanges joined by a 7 inch length of 3 inch PVC tubing. A ball bearing was mounted in the table top in the center of the azimuth scale; a second bearing was also installed in the pedestal near the bottom of the PVC tube. These bearings accept the 1/2 inch steel shaft and allow for exceptionally smooth loop rotation. As the loop is rotated, bearings can by read off the azimuth scale through the pointer.

This arrangement solves most of the problems I had encountered with loops I had made previously. It is relatively compact and does take up precious desk space. Most of the mass in the loop is concentrated towards the bottom which of course aids its mechanical stability. The overall balance of the loop is good enough that the lower flange will prevent the entire loop from tipping over in all operating positions. The use of ball bearings results in a very nice "touch" when adjusting the loop in azimuth.

Remember that this loop and frame represent my preferences in construction. They are also a reflection of what was in my junk box and wood scrap bin. You can choose any construction methods with which you feel comfortable. Just keep in mind the desirable attributes of a good DF loop: rigidity and stability of both the loop and base, freedom of rotation in both the azimuthal and elevational planes, and a good amplifier to allow the DFing of that elusive DX. You should also try to keep the elevational pivot point vertically aligned with the center of azimuthal rotation, and try to minimize the overall height. Both of these will aid mechanical stability. At some point you will become aware that your loop is more than just an antenna but is also a sensitive instrument for measuring the arrival angles of incoming radiation.

I recommend strongly that you consult relevant National Radio Club publications such as [2] and [4]. These publications contain a wealth of ideas which may guide your construction. In particular, either the 2 or four foot NRC loop frames can be scaled to the 18 inch dimension suggested for shortwave. Also offered are several noteworthy approaches to building a base. A catalog of available NRC publications is also available from the National Radio Club, Publications Center, P.O. Box 164, Mannsville, New York 13661.

THE FARLEY LOOP: A USER'S REVIEW by Mitch Sams

Over the past two years Joe Farley and myself have spent a fair amount of time on the phone discussing directional antennas for shortwave. We traded ideas

and opinions about just what would be a reasonable approach to a directional antenna system for shortwave. Joe's article in PROCEEDINGS 1989 [3] laid the groundwork for the exceptional loop antenna which he has now built, and which I have had the opportunity to use for the past three months.

I was very impressed with the professional quality of work which Joe had put into the loop. Heavy duty wood construction in the loop with countersunk screws, beveling, wooden dowels, and everything. The electronics (amplifier and tuner) were custom made and looked like they had just come off the assembly line at JRC. Even the ball bearing assembly used to swing the antenna in azimuth was smooth as silk.

I reconstructed the loop and hooked it up. Turning it on with my receiver I noticed no signal level being reported at the receiver. "No problem, just need to tune the antenna preamp and I should see a little gain out of it". Boy was I surprised. My S-meter on the FRG-7 came to life; this loop was hot! At the time all I had was a 65 foot longwire running east-west, and a 65 foot longwire running north-south. When I switched between the loop and either of the longwires, the loop outperformed both by 1-3 dB! I couldn't believe it. Later I was able to compare the loop to a 100 foot and a 200 foot longwire. The loop put the S-meter about 3 dB below where the longwires did, still surprisingly good and not that noticeable to the ear.

I remembered a user review of Joe's loop by Mike Nikolich. Mike pointed out that the loop seemed quieter than the longwire. I agree, the loop at times is quieter than the longwire. In my case I think the noticeable difference in the levels of noise present on the longwire versus what is present on the loop is due to some low-level background that the loop is able to reject.

I should also point out that in the three months I have owned the loop I have only used it indoors. I have the loop on the second floor of our wood frame home. I have also used the loop while inside a metal exterior trailer home. The results I will report were obtained while indoors at both locations. I would expect some amount of improvement if I were to move the loop outdoors.

AZIMUTH DIRECTIONALITY. The Farley loop tunes from 120 meters to just below 49 meters, but it is still useful outside of that range. Two nulls exist broadside on both sides of the plane of the loop, with the peak of the pattern occurring when the edge of the loop is pointed at the station. One shouldn't get the idea that the loop nulls are extremely deep and pronounced; this is not always the case. Depending upon the mode (number of hops, etc) and signal-to-noise ration at the receiver, the nulls may be very noticeable or difficult to find.

I first tried the nulling capability of the loop by tuning a strong Latin on 60 meters. No problem finding the null; the station was attenuated by about 40 dB. As I swung the antenna back and forth across the station I could see the S-meter dip again and again. On weaker stations the null would put the signal into the noise, completely eliminating the audio.

But this is not always the case. On very weak signals the null can be difficult to find and is hard to hear. Fading also makes nulls extremely difficult to locate. It is hard to tell the difference between a fade down and a null while scanning with the loop. Fading also changes the phase relationship of the incoming signal, which sometimes makes the null move around.

With practice I can achieve about 5 degrees of accuracy in azimuth for determining the bearing of a station.

ELEVATION DIRECTIONALITY. It is possible to tilt the loop in elevation as well as azimuth. At first this didn't seem to be very useful, however, I've since learned that this is very effective against local noise. In most cases, this noise is very directional, even in elevation. For example, when the TV is on at night I can point the loop broadside to where the TV is located downstairs and at the other end of the house and the TV interference will go completely away. This is a help later in the morning when the tropical bands begin to fade and are overtaken by local noise. I can delay the complete washout of the band a bit by using the loop.

As far as elevation directionality for shortwave stations, I've not had much success there. However, there is one interesting thing that can be deduced

from the elevational directionality that is a big help. I believe that I am able to tell the difference between a one hop station and a multi-hop station by tilting the loop in elevation. The one hop station usually peaks about +10 degrees while long distance stations with multiple hops are near +3 degrees. When the higher elevation angle peak is detected I can assume, under normal conditions, that the received signal is probably within a 2000 mile radius of my location.

EXAMPLES. Now, let me relate some specific loggings and how the loop performed.

At 0140 UTC with my longwire switched in, I tuned to 4755 kHz and the Brazilian, R. Educacion Rural, Campo Grande. There was a pulser ute interfering with the Brazilian on this frequency. I switched in the loop and swung the antenna around to the southeast. At a bearing of 140 degrees, the S-meter dipped to its lowest point. I looked on my azimuthal-equidistant map plotted with my QTH (Wichita) in the center, thus providing a straight line path to any other point in the world along an angular bearing in azimuth. Campo Grande was at 144 degrees; I was off by only 4 degrees! The most significant thing about this logging, though, is that the pulser ute on this frequency was nulled enough to where it was not a problem anymore. I swung the null around looking for the ute's bearing. I found it ti be at 250 degrees. This was the ideal case for an interfering station; it was 90 degrees away from the desired station. A null could be put on the pest while the desired station would be near the peak of the loop response.

Other stations were checked. Rebelde, Cuba, on 5025 kHz was right on with no error at 130 degrees. R. Tarma, Peru, was at 150 degrees with a 2 degree error. Buenas Nuevas, Guatemala, was right on target at 160 degrees.

UNIDENTIFIED STATIONS. What a help this loop is in gathering clues to the identity of unidentified stations. For example, I tuned to a Brazilian at 0230 on 4815. There is more than one Brazilian listed here and I didn't have an ID yet. The null was at 145 degrees which was very close to the city of Benjamin Constant, home of a Radio Nacional outlet. The other listing on 4815 in Londrina is much further east and is located at 138 degrees.

The loop can save a lot of time by giving you strong evidence as to the identity of an unknown station which may turn out to be something you are not interested in DXing. For example, another unidentified station was on 4840, a Latin at 0235. Should I waste my time here? "Not if it's Radio Valera. But if it's the Ecuadorian or Peruvian, that might be worth sticking around for" I thought to myself. Swinging the antenna around I found the null at 145 degrees which ruled out Valera. Later it turned out to be the Peruvian.

It is now easy to tell which Canadian regional I have on 6160, Vancouver or St. Johns, because the angular spacing between the two is so great.

One morning I came across a carrier on 3277 during a good opening to the subcontinent. I was naturally interested in this one since Kashmir is active on this frequency, but I didn't want to waste time here if it was Jakarta while other Indian regionals were coming through elsewhere on 90 meters. A null check with the loop revealed just what I had hoped; the bearing was right on for Kashmir, not Jakarta. I stuck with it and sure enough it was Kashmir. The loop did a good job of clueing me in on some potential DX and allowed for more efficient use of my time.

TRIANGULATION. Recently I wrote a simple computer program which allows me to take two bearings for the same station from two different locations and triangulate the location of the received station. If the station is located near broadside to a line drawn between the two DXers' locations then the accuracy of determining the station's latitude and longitude is within 0.5 degrees. If the station is more parallel to the imaginary line then the accuracy gets pretty bad. If there were a group of DXers strategically located across North America then it should be possible to accurately determine the position of received signals.

It is particularly interesting to find the location of a clandestine station. So far my results have pretty much matched the published locations of some clandestines. I'm waiting for a new one to come on the air to test out the system. (I guess this capability might make pirate broadcasters shudder a bit!)

SUMMARY. I am extremely happy with the performance of this loop, and I am surprised. Nulls are about 40 dB deep on average and about 20 degrees wide. It has sufficient gain, effective noise reduction capability, it's portable, works indoors, and of course is directional and steerable. I find that the loop is now used a majority of the time when I am DXing the tropical bands.

GETTING STARTED

You might be tempted to dive right in and begin assembling a DF loop of your own, and that is understandable. Before you do, however, it would be very worth your while to investigate your listening environment, solidify your expectations, and gauge how much time and money you wish to invest in this project.

Without a doubt, the first step is to gauge the intensity of noise pollution in your listening shack. In the ideal situation you would like to be able to both hear and DF tough DX in the comfort of your shack. The loop described will have enough sensitivity to hear DX indoors. But sensitivity is a double-edged sword as the loop will also be able to hear the local QRN emitted by appliances in your house. In my experience, noise has been traced to most of the classic QRN sources such as the refrigerator, furnace, lamp dimmers, VCR digital readout, etc. This is not a major problem; just pull the plugs during DF sessions!

More serious is the noise which is apparently and mysteriously conducted along and radiated by the house infrastructure. This includes house wiring and conduit, gas and water pipes, telephone wires, and possibly even the CATV cabling. In many houses (including mine) electrical service is just plain noisy from the service entrance on. Filtering outlets IS effective in reducing noise in the receiver when an external antenna is employed. An indoor antenna still sees the noise radiated by conduit et al, and this type of noise seems to be the major obstacle to serious DFing here. It is a pernicious type of noise that appears in bands coinciding roughly with the 120, 90, and 60 meter bands. Natch! The intensity and "signature" of the noise varies daily, but it is typically at S9 or better with an indoor loop. It is always inaudible with a similar loop sited outdoors about 30 meters from the house. The noise seems to take vacations; typically one day in fourteen is quiet enough to do any serious work.

You might benefit from this hindsight by surveying your listening environment for noise sources with a portable receiver tuned to a clear channel in a band of interest while it is active. Gauge the stations that can be simultaneously heard on that band, and their strength relative to the noise. Do this over a period of several days if possible.

Alternatively, you might wish to install a temporary antenna consisting of a 10-20 foot length of wire near the ceiling in your shack. Use a wire antenna tuner if you have one. Try to DX with this antenna, while gauging the relative reception of both DX and noise. Try also to compare noise pickup to the external antenna with which you normally DX. If you do this over a period of time, you should be able to get a fairly good idea of the noise in your shack relative to outdoors.

If the results of your surveys indicate that you are consistently able to hear modest DX with a relatively low amount of noise, I think that you should consider building an indoor loop. A good approach would be to obtain or build a loop amplifier, and to build a test loop on an 18 inch square cardboard box or scrapwood frame. Use the dimensional guidelines cited in [3], but don't be overly concerned about getting the dimensions exact. The idea here is to make a crude test loop. DX with it and try to obtain nulls on a variety of stations by steering it with your hand. Try using the loop in different rooms in your house if possible, and by all means, give it a try outdoors. Gauge whether its performance indoors justifies the construction of a good frame and base. Gauge the outdoors performance; would it justify the time and expense of putting the loop on a rotor? Think again about your goals and expectations, and use the solid facts you learn along the way to determine the course corrections you must make.

If the results of your surveys indicate that you are consistently unable to hear modest DX with a relatively low amount of noise pickup, your choices are

more limited. The probability that a DF loop will work well for you indoors is not very high. If you are intent on DFing, you could assemble the makeshift loop and analyze its performance indoors and outdoors. If it does perform to your expectations indoors, that is great; the decision to build a frame is yours. If it does not perform well indoors but does work outside, you might still wish to build a good frame so that you could DF outdoors or on DXpeditions.

You may decide that your only recourse is to mount the loop outdoors and use a calibrated rotor to steer it. Personally speaking, this is the course of action which will best solve the noise problems in my particular environment.

A light duty commercial ARO rotor such as the HyGain AR-40 (about $180) should easily be able to steer this loop in azimuth. I cannot comment as to its accuracy, but a rotor of this type should be suitable for low accuracy DF work. It might also be useful for those who wish to investigate the possibilities of using a loop to avoid co-channel QRM or local QRN.

Radio Shack and Handy Andy (or similar DYI superstores) carry a light duty rotor meant for FM and TV antennas. These run in the neighborhood of 50 to 60 dollars and are a bargain. Other names in the rotor market include Alliance and Daiwa, and you can check the catalogs of amateur radio supply houses for more details.

GETTING YOUR BEARINGS

As I scan the bands I find a signal which gets my heart pumping. It is weak and is fading periodically. It shows a fair carrier, and a trace of audio. Let's see how to go about getting a bearing on it.

I like to spend the first couple of minutes slowly scanning the loop panoramically (rotating a full 360 degrees and then back) while watching the S-meter and listening for clues to a tentative null bearing. It is not easy to find a null, but after several full scans I become convinced that the signal strength always decreases as the loop pointer crosses 4 degrees and 180 degrees approximately. The null at 4 degrees is more pronounced, and I mentally log this as my tentative null location. I do a few more scans and I note that the signal always seems to peak near 89 degrees and 273 degrees. My confidence is bolstered, as the loop seems to be showing a good response pattern. I could accept this bearing as being the wave arrival, but I do not have much confidence that the null is found at this singular bearing; the best I can guess is that it is in the general area of 4 (possibly plus/minus 5) degrees. I want to get a more accurate bearing by doing some "fine" scans.

I swing the loop around to 89 degrees (one of the signal peaks) and ensure that the loop tuning is peaked. I then switch off the receiver AGC and preamp (if on) and set the audio gain to maximum. I swing the loop around to the tentative null at 4 degrees and adjust the receiver RF gain so that the signal is barely perceptible as audio. I sweep the loop through a small arc between 340 and 20 degrees while riding the RF gain control. I make several passes through the tentative null while adjusting the RF gain between scans to account for periodic fading. What I am trying to find is a setting for the RF gain which will cause the audio to disappear at one precise loop position. I am watching the loop pointer only as I swing the loop, while listening to the audio. I find that if I park the loop near the suspected null that I can deepen the null by adjusting the loop's elevation. I continue scanning while I keep a mental average of the azimuth at which the audio disappears on each pass. I disregard any apparent nulls which seem to be caused by a sudden fade down, and try to use only those nulls which are caused by loop rotation alone in my mental average. As the data accumulates I realize that my initial estimate was not that bad; the majority of the nulls on these fine scans show up at about 2 degrees. I decide that I really do have a high confidence level in this bearing; into the logbook it goes!

This technique requires much manipulation of your loop and receiver RF gain control. Alternatively, the loop tuning control can be used to make fine gain adjustments, especially if you used a ten-turn pot for the tuning control. If you mount the control box on the loop base then everything you need to make these fine bearing measurements is right there in front of you. There is nothing to distract you from what is important, and that is taking good data!

ABOUT CALIBRATION

I do not think that you can discuss DFing geographically distant stations without mentioning how to calibrate your loop to global geographical coordinates. Your DFing results obviously cannot be accurate if your calibration is not accurate. There are several methods available, and you must experiment to find one which suits you.

It would appear that the simplest method would be to use a magnetic compass (mounted on your loop table) to align the 0 degree bearing of your azimuth scale to magnetic north. To do this, you must account for the fact that in most areas in the world magnetic north does not coincide with geographical north. Also, you must compensate for the fact that in most locations the magnetic north you measure on a compass does not coincide the the north magnetic pole. It generally differs by a small value known as the local magnetic declination. I do not recommend this approach except for a quick DF check in which accuracy is not that critical.

A better method is to use stations with known transmitter sites (operating in your band of interest) as references. Before a DF session, you can take bearings on two or more known stations with the loop (and therefore the azimuth scale) in a fixed position. You can then obtain theoretical bearings on these reference stations from your azimuthal-equidistant map or from a bearing generation program such as the one supplied in the Low Band DXing software package (by John Devoldere, ON4UN, available from the ARRL, 225 Main Street, Newington, CT 06111). Your loop (or scale) can then be rotated so as to give a best fit between the theoretical bearings and the bearings you measured. Or, you can leave the loop where it is and add or subtract an offset (the amount you would have to rotate the loop) from all subsequent DFs. This method allows you to know the station location while you are nulling it.

All DXers are aware that it is quite easy to imagine a station ID; given the speaker's language, a scrap of music, and a frequency/time/propagation fit, you will hear an ID no matter what was said! Similarly, if you do your calibration before you DF, I guarantee that you will always hear a null at the precise bearing at which you hope it will show up! Within a few days of starting DFing you will have memorized the arrival bearings of all your favorite quarry. It will be quite difficult to keep this knowledge from biasing your results, and this fact suggests a third method of calibration.

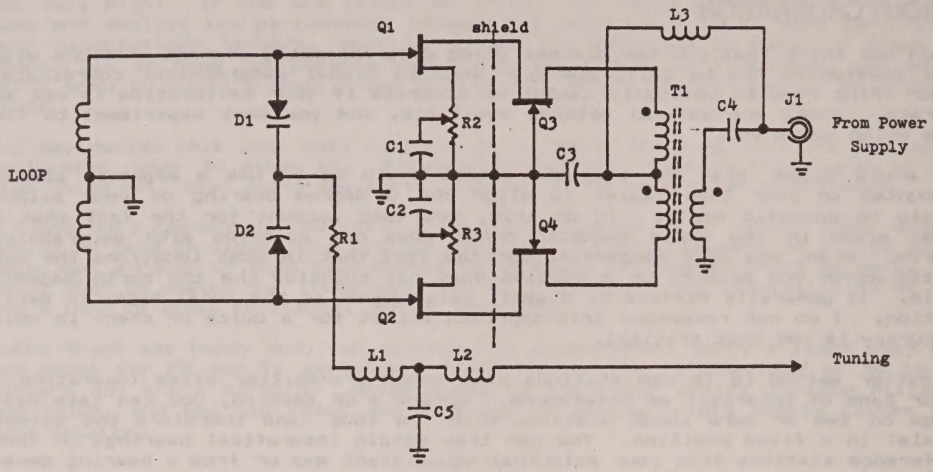
In this method you do your DFing first, with the loop and azimuth scale firmly fixed in a random position so that the scale bearings do not correspond to world coordinates. After DFing, you calibrate against known stations as previously discussed. The azimuthal correction factor that you derive from this calibration is then used to correct any bearings you took in the DF session. The major advantages of this method of "blind calibration" are:

1) In the event of a band opening (especially a quick one) precious time is not wasted in calibration.
2) You have no concrete knowledge of the actual bearings you are trying to determine; bias is minimized.
3) In the event that you take no "high confidence" bearings in a session, no calibration is required!

A "UNIVERSAL" LOOP AMPLIFIER

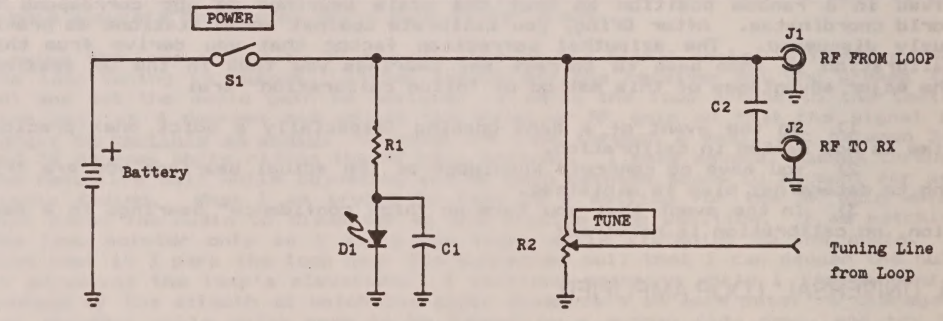
The amplifier described in [3] is suitable for use in a DF loop. With a loop inductance of 32 uH, a coverage of 1800-5200 kHz will typically be possible. "Remote" tuning is used in this scheme, and only a single coaxial cable is required between the control (power supply) and the loop amplifier.

Fig. 1 and Fig. 2 illustrate an improved amplifier and control scheme which I recommend for anyone wishing to experiment with DF loops. Fig. 1 describes an amplifier in which the coaxial cable is used to return RF to the receiver via the simplified controller described in Fig. 2. This coax is also used to bring a fixed +18 volts to the amplifier. The tuning voltage has been segregated from the drain supply; a separate wire is used for the tuning function. This circuit arrangement offers the following advantages:



C1-4	.05 uF, 50V ceramic disc	Q1,2	MPF102 JFET
C5	.01 uF, 50V ceramic disc	Q3,4	MPF102 JFET (U310 JFET may be substituted)
D1,2	MVAM115 (NTE618) tuning diode	R1	22K, 1/8W, 5%
J1	BNC bulkhead jack	R2,3	200 ohm trimpot
L1,2	270 uH molded inductor	T1	10T #32 AWG trifilar on Amidon FT-50A-77
L3	270 uH (15T on Amidon FT-50A-77)		

Fig. 1 LOOP AMPLIFIER



Battery	18V (three 6V lantern cells in series)	J1,2	BNC bulkhead jack
C1,2	.05 uF, 50V ceramic	R1	10K, 1/8W, 10%
D1	any LED	R2	10K, 10-turn pot
		S1	any SPST switch

Fig. 2 LOOP CONTROL BOX

1) The overall circuit power dissipation is significantly reduced. Battery operation is feasible, and three 6 volt lantern cells in series will help to ensure quiet amplifier operation, and they will have a long life. Battery operation will also allow the loop to be used on DXpeditions.

2) The control box is greatly simplified; both cost and construction complexity are minimized.

3) This circuit will produce a tuning voltage of 0-18 volts. Although it is not a recommended practice, running the varistors at a reverse bias of 0 volts will result in a tuning minimum of approximately 1400 kHz. MW stations of known location may then be used for azimuthal calibration points. The MVAM115 (NTE618) diodes are specified for a 15 volt reverse bias maximum operating, and 18 volts maximum. The controller described in Fig. 2 will allow operation up to the 18 volt limit. This does not appear to pose any threat to the diodes; every unit that I have tested withstood 21 volts reverse bias ("high temperature") without degradation. Practical experience suggests that the ability to tune a couple of hundred kHz higher (to 5400 kHz typ) is worth pushing the limits on these devices.

4) This circuit will work nicely for either an indoors DF loop or for an outdoors loop on a rotor.

The amplifier should be built along the guidelines outlined in [3], and should be housed in a metallic enclosure. I like to use a 3.6 x 1.5 x 1.0 inch aluminum diecast box (Hammond Manufacturing #1590A or Bud #CU-123) that has tight-fitting lid which is secured by four machine screws. This enclosure helps to make the amplifier a compact and rugged unit, and it can be easily waterproofed for external use.

The MVAM115 diodes will be difficult to find in small quantities. A suitable replacement is the NTE618, which is an aftermarket replacement for the Motorola part. Mouser Electronics distributes the NTE line, and although they do not currently list the '618 in their catalog, they should be able to get them for you. The price should be about $2.50 each. Information on this and other amplifier parts can be found in the reference section at the conclusion of this article.

The MPF102 JFET pairs should be selected and matched for zero-gate drain current (Idss) as described if [3]. Using these FETs, the amplifier gain should be suitable for most applications and listening environments. If you have access to some U310 JFETs, you may try them instead of the MPF102s at Q3 and Q4. This will result in a somewhat "hotter" loop, and it may be useful in areas free from local RF pollution. If you wish to go this route, keep the U310 gate leads in your layout as short as possible. Also, choose Q1 and Q2 to have the highest matched Idss possible; a value of 12-15 mA would be acceptable.

The control box is quite straightforward to construct, and it may be built in an enclosure of your choosing. The ten-turn pot and counting skirt (optional) may be obtained from Digi-Key Corporation.

Connectors and cabling are not critical, and should reflect your preferences. The loops I built use RG-174 miniature 50 ohm coax for the RF path between the loop amplifier and control, with BNC connectors at the loop amplifier and control enclosures.

EPILOGUE

The potential for DFing with small loops has barely been explored in the shortwave hobby. Many questions remain unanswered, and there are many areas yet to be explored. Among the most interesting are:

1) For the most part, the null patterns observed in practice are consistent with simple theory. In some instances, "pattern skewing" (and/or degeneration into single or multi-lobed response patterns) is observed. Why is this so?

2) These loops generally produce the classic "figure 8" response, and a station which shows an arrival null at a given bearing will generally show another 180 degrees away also. The accumulated knowledge of propagation, band openings, and station identifiers will usually allow the easy elimination of one of the possibilities. For example, there is probably not much reason for a Slavic language numbers transmission to be arriving from the far southern Pacific rim at 0500! It is well known that the pattern of an omnidirectional an-

tenna (short vertical?) can be combined with a loop response to generate a pattern with a single null (cardioid). This would be a great area for some individual research.

3) Improved calibration methods are needed, and a larger user pool will allow a better determination of the accuracy which is possible.

4) More research into elevational arrivals is needed. Such information is vital in attempting to reconstruct a hypothetical transmission path back to the transmitter.

5) I make no pretenses that the loop and amplifier combination is ideal; it simply works. The loop area, number of turns, loop Q, tuning range, winding spacing, and amplifier have settled into a recipe which I tend to duplicate with each new loop. Card holding members of the Tinkerers Union are welcome!

ACKNOWLEDGEMENTS

The authors wish to acknowledge those members of the medium and longwave community who pioneered the use of loops and hobby DFing. In view of this, our current work is but a footnote to their endeavors.

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[1] Connelly, Mark, WA1ION, "RT-1 Remotely Controlled Antenna Tuner", I.R.C.A. Reprint A66, 1984, International Radio Club of America.

[2] Edmunds, R.J., ed. N.R.C. Antenna Reference Manual, Vol. I and II, 1982. National Radio Club.

[3] Farley, Joe, "A Remotely Tuned Loop Antenna", fine tuning's PROCEEDINGS 1989, 1989, FT Special Publications.

[4] Knitter, Michael G., ed. Loop Antennas Design and Theory, 1983, National Radio Club.

SOURCES OF SUPPLY

Amidon Associates -Ferrite and iron powder toroids
12033 Otsego Street
N. Hollywood, CA 91607

Digi-Key Corporation -Electronic components
701 Brooks Avenue
P.O. Box 677
Thief River Falls, MN
56701-0677

Mouser Electronics -Electronic components
P.O. Box 699
Mansfield, TX 76064

To help to support your efforts, I will be able to supply the "universal" loop amplifier described in this article in kit, partial kit, or assembled and tested form. For details, send an SASE to Joe Farley, 910 Westwood Avenue, Addison, IL 60515 USA.

receivers

ANTIQUE COMMUNICATIONS RECEIVERS: COLLECTING AND RESTORING TECHNIQUES

Chuck Dachis
"The Hallicrafter Collector"

PART ONE: THE STORY

My involvement with electro mechanical devices extends back to my early childhood. As a toddler I was not interested in playing with the usual toys designed for children of my age, but rather the neighbors discarded toaster, burned out electric fan, or an old carburetor! My mother didn't see any problem with this until one of her friends admonished her for letting me play with this "junk" instead of buying me "proper" toys. Being embarrassed by this, and also sensitive to my needs, she decided to convince me to play with "normal" toys by using a very logical approach. She told me that all these old things were dirty and could cause germs, so it would be a good idea not to play with them any more. I have always had a very logical and orderly thought pattern, approaching that of the "scientific process". At age 3 or 4 my response to this problem of "germs" was simple. I took all my "junk", through it in the bath tub and washed it! Mother told her friend to mind her own business!

I have always had an affinity for mechanical and electronic devices, and wanted to know what made them work. My dad wouldn't let me take apart the family radio because, he said, "it works fine, and if it works - don't fix it"! So at age 8 I found an old Philco "Cathedral", plugged it in, and watched it smoke and blow a fuse (no, I didn't wash it in the tub). I excitedly rounded up some of my dads tools and started an autopsy, completely disassembling the set and studying all the weird little parts it yielded. During the next few years I dissected probably 200 radios, most of which collectors would give their eye teeth for. By age 12 I was quite familiar with the mechanical principals of radio construction, and could identify parts and understand their function.

One of the radios I purchased at the local "Goodwill" store for one dollar (a half weeks allowance) was an RCA 816K. It was scheduled for major surgery so it would fit in my "rocket ship" control panel ("Tom Corbet" and "Captain Video" were my heros). I had it out of the cabinet and on the bench when it's grandeur suddenly hit me and I couldn't cut it up (the 816K has always been very special to me and though I sold it a year later and haven't seen one since I have had many dreams about it). I decided I would get it working, and I did! It was a real triumph, and also marked a turning point in my relationship with radio.

I was no longer interested in taking them apart, but rather wanted to fix and use them. The more frequency bands, tubes, dials and knobs they had the better I liked them. I called these sets "super radios". My first Hallicrafter was the SX-28, which certainly fit the "super radio" classification. It was also my first communication receiver. I became an avid AM and short wave DX listener. Whenever we would take cross country trips my dad was always amazed because no matter what city we were in I knew the call letters and frequencies of the stations.

THE DREAM STORE

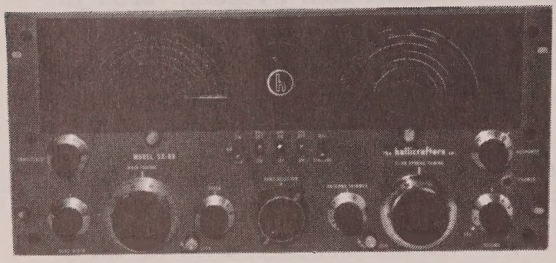
During the next 13 years I was looking for bigger and better radios and found few, but always hoped I'd find a "dream store" with wall to wall and floor ceiling "super radios" at a price I could afford. I never found that store! My interest in radio waned for a decade or so and most of what I had acquired was given away or sold.

In 1973, I decided (again) to start a collection of "super radios" of all brands. The first radio I wanted, for nostalgic reasons, was the SX-28. Not knowing where to look, it took over 6 months of advertising in the local newspaper to find one. The one I found had been in a flood, was full of mud and in awful condition. It had taken so long to find that I considered it rare, and

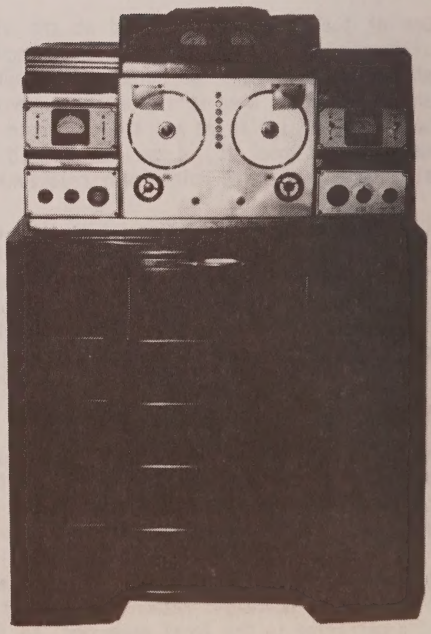
SX-100

SX-122

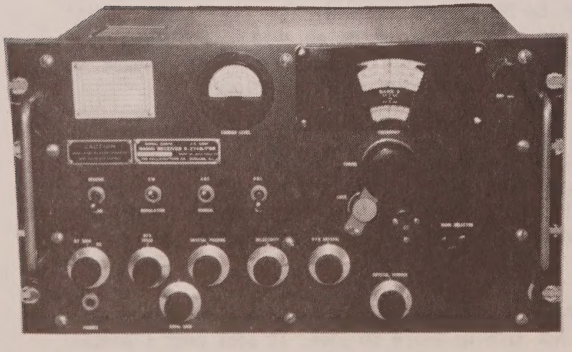
SX-88

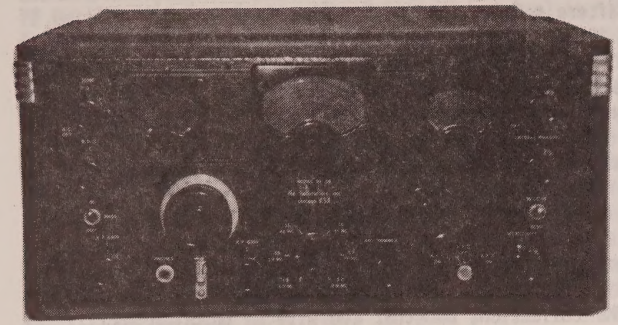


Model DD-1
Sky Rider Diversity

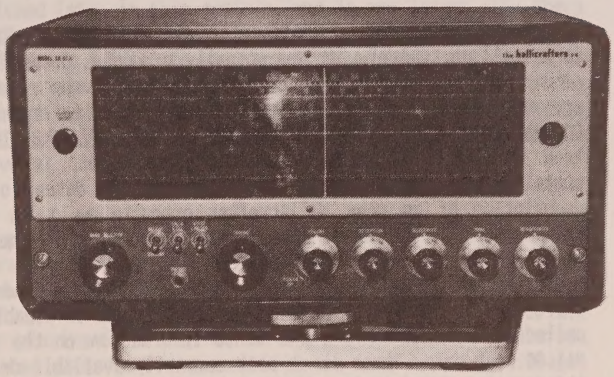


SX-73



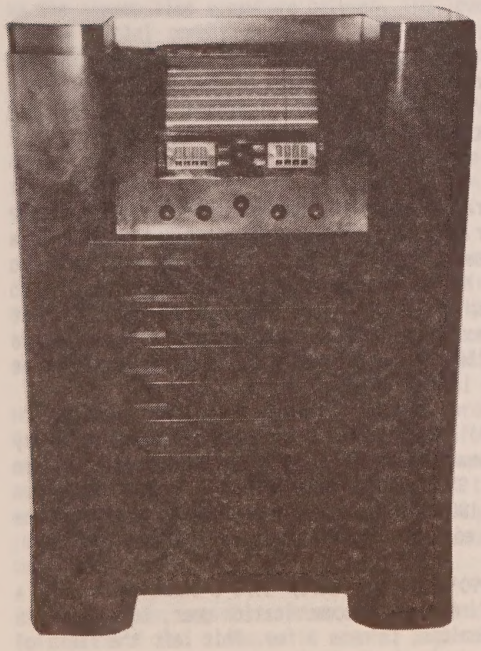


SX-28

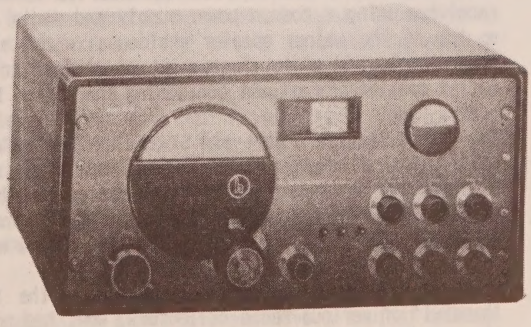


SX-62

RCA 816K



SX-42



proceeded with my first "modern" restoration. While looking for the SX-28, I came across an S-36. Until this time I never knew Hallicrafters made anything other than SX-28's, and realized if there was a 28 and 36, there must be a 29 and 37. With almost no documentation available, finding and collecting all Hallicrafter products, technical data, advertising and promotional items would be a challenging and exciting project. It quickly became apparent that I would need to specialize. My collection currently contains over three hundred different major equipment items displayed on wall to wall and floor to ceiling shelves, and hundreds of original technical manuals, advertising brochures, and smaller accessory units. I have *created* my "dream store"!

Because I acquire about ten to fifteen sets per year, display space for the collection is a real problem. The bulk of the collection is currently in the second largest bedroom in the house, which has been *full* for at least two years. There isn't a closet that doesn't have at least one radio stored in it, and they are starting to creep out into the other living areas! I am building a 500 square foot addition to house the collection, but that too will be outgrown shortly. My goal is to open a museum with adequate space so this wonderful and unusual collection can be enjoyed by any one who is interested.

When most of us think of Hallicrafters we remember the SX and HT line of Ham and SWL sets. This is a small portion of what was actually produced. Documentation has become as important to me as acquiring the products. Most of the original company records were either lost or destroyed years ago, and until I published the first edition of my comprehensive product list, THE HALLICRAFTER COMPANY: 1932-1982, A PARTIAL PRODUCT LISTING COVERING FIFTY YEARS OF PRODUCTION, in 1983 no one knew just what the company produced. This "list" is over thirty pages of condensed type and contains the model numbers, names, production dates, original prices, and a brief technical description of as many Hallicrafter products as I am aware of, along with some historical information on the company and comments on some of the equipment.

I am constantly finding new models and product lines I never knew existed, and just published the third edition in late 1989. This "list" is an invaluable tool for any beginning Hallicrafter collector, or for someone who wants information on the products, and is available from me at $11.00 post paid. There is no book currently available dealing exclusively with Hallicrafters or it's complete product line but I am working on it, and will use the "list" as the foundation for the product section.

There are several books available that give a good cross section of information on many different brands including Hallicrafters. Two that I would recommend are "A Flick Of The Switch 1930-1950" by Morgan E. McMahon, published by "Vintage Radio" (Box 1331, North Highlands, CA. 95660), and "Communication Receivers, The Golden Years" by Raymond S. Moore (RSM Communications, P.O. Box 218, Norwood, MA. 02062).

What were the biggest, best, and most exotic general coverage receivers built by Hallicrafters? There were four. The most exotic was the Sky Rider Diversity, model DD-1, produced in 1938 at a cost of $550.00. A twenty-five tuber that stood nearly four feet tall, three feet wide and two feet deep. It's frequency coverage was .55 to 45 Mhz in six bands. The unit was actually two receivers using a common power supply and audio amplifier. The black steel and chrome tuner sat on top of the walnut speaker enclosure, which also had a pull out writing desk. The separate power supply and audio chassis sat on shelves in the speaker cabinet along side the sealed base reflex speaker compartment containing the Jensen 15 inch pm speaker.

The "best" receivers were the SX-28, SX-73 (R-274D) and the SX-88. The DD-1 and SX-88 are very difficult to find, the SX-28 is still relatively common, and the SX-73 is becoming scarce but can be found. Other "good" Hallicrafter sets are the SX-42, SX-62, SX-100, and SX-122. Good non Hallicrafter radios I recommend are the HQ-170 and 180 by Hamarlund, The NC-183 by National, the R-390/URR, and there are many others (see photos at end).

What can the beginning collector expect in the 1990's? In the early 1970's there were only a "handful" of serious radio collectors, most had no interest in communication gear, but rather in the grand old Scotts, Midwests, Atwater Kents and Zeniths, to name a few. This left the field of collecting vintage communication equipment wide open and relatively inexpensive. There was little

demand for it and I was able to buy many radios in the five to twenty dollar range, and as often as not was told I could have it if I would just haul it off!. Unfortunately, this is not the case today.

In the past few years there has been a tremendous resurgence of interest in antiques and collectable items of every description, especially antique and vintage radios of all types. This has driven the price of most of these items to levels where only the well off can contemplate a collection of considerable size. Most of the radios bought today are by what I call "mini collectors", those who want from one to a dozen or so sets. For most, the emphases is on owning these radios and not on restoring them. Don't despair, there are still some good deals out there.

The twenty to sixty year age of these vintage radios means they will almost certainly need considerable work to bring them back to their original glory. Once properly restored they will usually provide many more years of good service. For those of you who are not technically inclined but want to own and operate one of these radios, good news! One of the "spin-offs" of the antique radio "boom" is the reappearance of technicians who know how to work on these sets. Several advertise in the magazines mentioned later in this article, and in any larger city there is likely to be one or more vintage radio repair shop listed in the phone book. But be careful for it would not be unusual to spend $300.00 to $400.00 to have the SX-28 or other vintage "super radio" restored! For those doing their own restorations and who want a refresher course in radio repair I recommend Practical Radio Servicing by William Marcos and Alex Levy, published by McGraw Hill in 1953.

PART TWO: THE RESTORATION

"This radio has been completely restored". How many times have you heard that statement? What does it mean? "Restored" can mean different things to different people. I have seen radios where "restored" meant that the dust was wiped off, a tube or two and a capacitor was replaced just to get them to work. I have also seen "restored" radios that have been completely disassembled, all metal parts refinished to exact paint or plating formulas, new lettering silk screened on the new finish, all components and wiring replaced with "new" components of the same type and vintage, and new plastic parts molded from old formulas. Would this radio be restored, or is it new? For me the answer lies somewhere between. The level of detail for each restoration I do will depend on the initial condition of the radio, rarity, its value, and the availability of parts. For some, other considerations may include funds to purchase parts and on ones own skill, time, and desire.

Start the restoration with an overall physical cleaning and examination of the radio's general condition. Any physical or mechanical problems or modifications that would impede the electrical restoration are handled first. Remove any non original switches, "magic tuning eyes", or meters that may have been added and fill the resulting holes in the front panel, chassis or case. This can be tricky! I generally back the hole with metal duct tape, then fill with several thin coats of automotive "Bondo", lightly sanding between each coat. Once it is dry and sanded smooth I "spot" paint the repaired area with an "air brush", blending it into the existing finish. Matching the paint is very important, and will be discussed in more detail later. Depending on the location of the hole, the panel may have to be removed and if any original controls or switches are broken, bad, or missing, they will be replaced at this time.

Having fixed the physical and mechanical problems we can move to the electrical restoration. Remove all modifications, rework sloppy former repairs, and return all circuitry to the specifications of the original factory schematic. Next check the small components, starting with paper and wax by pass capacitors. To check these capacitors you need not remove them, but can carefully de-soldered one lead, disconnecting it from the circuit, then check for "leakage" resistance on the high range of a good analog VOM (the digital units do not work well for this test).

It has been my experience that most of these capacitors are "bad", and have a typical leakage resistance of 100 K ohm to 10 megohm, I generally replace all of them. There are three reasons "leaky" capacitors are replaced; First, a circuit will not operate properly when a capacitor is

acting more like a resistor. Second, the leakage current through a dozen or so capacitors can create enough additional "load" on the power supply to cause failure of the power transformer, rectifiers, and other power supply components. And last, when I restore a set I want it to work for a long time. If I didn't replace all these capacitors, sooner or later (usually sooner), they will fail. The mica and ceramic capacitors are almost always good and will not generally need to be replaced or even checked.

Any resistors connected to the terminals we de-soldered wile checking and replacing capacitors will also be checked at this time, and replaced if necessary. Resistors are the next biggest culprit in degrading the performance of the equipment. It is typical for many of them to "look" perfectly good but be any where from 10 to 200 percent higher in resistance then the marked value (they are rarely lower). This causes a serious voltage deficiency in a given circuit, not allowing it to function properly. Any resistor that is more than 10% out of tolerance (high or low) should be replaced. A quick check of resistors can be done in circuit with the VOM. When you check in circuit it is not possible to get a reading higher than the marked value unless the part is bad. A suspected bad part can be de-soldered as we did with the capacitors, and a detailed check can be made. I recommend that only one part at a time be checked or replaced to avoid confusion. When replacing small components I use "state of the art" "mylar" capacitors (usually 600 working volts) to assure continued long lasting performance, and new resistors of proper type and values. These parts can be ordered from most electronic supply houses.

Now I get brave and apply power to see if it works, or smokes!. Usually it works but not always well. This means there is more to do. Check and replace any bad tubes, and any major component that may be bad (transformers, IF cans, and electrolytic capacitors). "Clean" the controls and switches with control cleaner, and finish the physical cleaning of the chassis and major components. Next we do a complete IF (intermediate frequency) and RF (radio frequency) alignment, in that order, following the factory instructions. The set should now work as well or better than it did new!

What do we do about dirty paint and lettering on the case and front panel? Most of the time the paint and lettering can be restored to it's original brilliance by using various cleaners and rubbing compounds. A mild automotive rubbing or polishing compound can be found in the automotive section of most K-Marts and will work well for this purpose. A light weight oil such as "WD-40" also works very well for cleaning and bringing back the sheen to dull paint. Caution should be exercised with some cleaners on some surfaces. Test everything on a small inconspicuous area first. There is nothing more disheartening than to take a dial or lettered panel and "clean" all the numbers or lettering off the surface! A mild dish washing detergent will usually remove most of the dirt and grime with no damage to paint or lettering. Extreme caution should be used in cleaning the numbered side of glass or plastic dials. Start with plain water and a soft cloth and do not rub hard. Avoid "Windex" and other glass cleaners because they contain ammonia which can dissolve the lettering.

Next you can touch up any paint scratches and replace any missing or faint letters with "dry transfer" lettering. The lettering I use is "MarKit JR." made by Russell Industries Inc. and is available at most electronic supply houses.

Your radio should now work and look almost as it did when it left the factory. Sounds simple doesn't it! Well, it's not! Here are a few more tips. Lead "dress" is very important. New components should be installed in the same space the old one occupied, terminals should be de-soldered and old leads removed. Keep new leads as short as possible and follow the same wire path as the old component. Making a drawing may help here. Some of these components are in places that seem nearly impossible to reach so it helps if you have some training as a brain surgeon and lots of patience.

TOOLS

In addition to the "usual" tools, I find surgical hemostats and tweezers very useful. A magnifier light is essential for those of us with failing eyesight, as is the service manual which will give the alignment instructions, parts lists and schematic. The only essential electronic tool

for most restorations is a good analogue VOM. Oscilloscopes, frequency meters, and signal tracers can make the job easier but are not necessary. For RF alignment I recommend using a signal generator, but it can be accomplished without one by using broadcast stations of known frequency on the standard broadcast band and WWV on the short wave bands. IF alignment can be done "by ear", but again I recommend a signal generator for accuracy and maximum performance.

MATCHING PAINT

Matching paint for cabinets and panels once presented problems until I took clean examples of the dozen or so shades of Hallicrafter gray and black to a local automotive lacquer company and had them mix up a quart of each. If a panel or cabinet is in very bad condition, I will acquire another rather than do a complete repaint or re-lettering job, unless of course the radio is very rare.

MAJOR COMPONENTS

Unlike the small components my philosophy is to use only original parts when replacing power, audio, and IF transformers. There is no commercial source for these parts so where do you find them? Well, the answer is simple, although somewhat costly. Sometimes I will purchase as many as five radios of the same or similar model to get enough parts to restore one. Many of the Hallicrafter models from a given time period used the same or very similar components. This gives me a choice of models to choose from, making acquisition of parts easier. If the radio is rare and needs a power transformer, and the chance of finding another is slim, I would have the transformer re-wound. One company doing transformer re-winding is The Peter Dahl Co. of El Paso Texas.

How do you find a forty year old radio of particular model to use as a source for parts let alone for your collection? I have been collecting Hallicrafter products since 1974. About eighty percent of my collection is acquired through my continuous ads in the national radio magazines, like "QST" (the journal of the "American Radio Relay League" 225 Main St. Newington, CT. 06111), "Antique Radio Classified" (P.O. Box 2, Carlisle, MA. 01741), and "Electric Radio" (P.O. Box 139, Durango, Co. 81302). Others are acquired at swap meets. It is my policy to buy any Hallicrafter product whenever it is offered if "the price is right" regardless of how many of the same model I already have. After 16 years I have built quite a stock of "parts radios" as well as duplicate sets used for trading.

This stock of extra radios makes restoration much faster than would otherwise be possible. If a front panel, dial, or power transformer is needed, it's off to my "parts department" with out waiting weeks or months to locate and obtain the part. I usually purchase tubes, and sometimes capacitors, resistors, power cords, and small items like rubber grommets, at swap meets. I have bought many hundreds of "new" military surplus tubes, usually in lots of a hundred or more for a few dollars. Admittedly, this is getting harder to do as most people are now selling by the tube and for a much higher price.

Purchasing radios and parts in these quantities is probably not a good idea for everyone. There are commercial sources where most tubes, manuals, and some components can be purchased in small quantities. One such source is "Antique Electronic Supply" (688 W. First St., Tempe, Arizona 85281). I can usually supply photo copies of Hallicrafter manuals, and if I can't "Ardco Electronics" (P.O. Box 95, Berwyn IL. 60402) usually can. For other brands you could use "HI Inc." (P.O. Box H 802, Council Bluffs, Iowa 51502), but there is a charge for their catalogue.

If it's a Hallicrafter you want, I enjoy helping others fulfill their nostalgic fantasies in either finding a specific model, finding parts to restore one they have already found, or just giving information about the company. I will answer any and all questions I can on Hallicrafters and the equipment. All I ask is a self addressed stamped envelope.

As a result of writing this article I suffered a acute nostalgia attack over the RCA 816K. I am happy to report that I have found one and have recovered. It is restored to museum quality and is once again part of my conscious life. The dreams have stopped! Happy hunting and good DXing.

GETTING THE MOST OUT OF ECSS

Gene Pearson

Many contemporary receivers used by DXers make reception in the ECSS mode very convenient. We switch to USB or LSB and tune through the signal until audio clarity is obtained. In most situations, the ECSS reception achieved in this convenient way is quite adequate, but it will not in every instance yield the most QRM rejection or readibility obtainable in the ECSS mode. And in the case of signals having one sideband QRM free, this approach does not render the full a.f. response obtainable from that sideband in the ECSS mode. The BFO offsets engaged by the USB and LSB switches are not chosen for maximum a.f. response but for typical ham band SSB applications. Yes, there is more to ECSS reception than can be had simply using the USB and LSB mode switches.

To take full advantage of the merits of the ECSS mode, we need to bypass the limitations imposed on our ECSS technique by the USB and LSB switches. Not all receivers allow us this option. Our receiver must have a panel BFO control to vary the BFO frequency through a continuous range of at least 4 to 5 kHz, and preferably 6 to 8 kHz. We must also be able to select manually any of its i.f. voice bandwidths when the receiver is in the CW mode. The JRC receivers - NRD-505, 515, & 525 - possess this flexibility, although the BFO frequency range of 4.5 kHz on the 525, the only one of these I know, is not wide enough to use with the stock "wide" filter for true ECSS. All the vintage "hollow state" radios used by DXers have the necessary flexibility. The current Icoms and the Kenwoods do not.

The purpose of this article is to describe how to use the kind of receiver flexibility just outlined to get the most from ECSS reception. This technique is not new. It was in use four and more decades ago, before USB and LSB mode switches, product detectors, and microprocessors were added to the radios used by DXers and hams. These devices did not create the possibility of ECSS reception. The BFO (also appropriately called a carrier injection oscillator) and i.f filters are what make ECSS reception possible. All receivers capable of CW reception contain a BFO. When the BFO is on, as it must be for CW, SSB and ECSS reception, it generates an unmodulated carrier on or near the receiver's last i.f. The BFO frequency control tunes the BFO carrier to any frequency between the control's endpoints; if properly aligned, at 12 o'clock the control makes the BFO frequency equal the i.f. The USB and LSB mode switches found on contemporary receivers simply activate the BFO at frequencies removed or offset from the i.f. by a preset number of Hz. Each switch is, in effect, a BFO frequency control offering us only one BFO frequency.

In CW, SSB and ECSS reception the BFO carrier is injected into the detector stage where it is mixed with the received signal arriving from the last stage of i.f. amplication. When an AM signal is received in the ECSS mode, only one, or part of one, of its sidebands arrives at the detector unattenuated. Its other sideband and the carrier are attenuated by the i.f. bandwidth filter before they reach the detector. The role of the injected BFO carrier in ECSS reception is to replace or 'exalt' the AM signal's attenuated carrier reaching the detector so that the detection process will not distort the audio of the AM signal. The BFO carrier "pinch hits" for the attenuated carrier of the AM signal.

You can easily experience for yourself the effect of this "pinch hitting". In the AM mode tune "nose on" to the carrier frequency of a QRM free AM signal. Begin gradually detuning from the carrier frequency into the sideband of your selection until the audio distorts. How far you must detune before this occurs depends on the i.f. bandwidth. It should occur detuned from the carrier frequency approximately half as many Hz as the 6 db i.f. bandwidth. Detuned that many Hz, the AM carrier is placed at the edge of the 6 db i.f. passband, which means the carrier strength will be 6 db less than it was when you were tuned to it "nose on"; the rejected sideband of the AM signal lies outside the 6 db passband and is rejected by an even larger factor. Now with the BFO frequency control set at 12 o'clock, switch to the CW mode. Tune the BFO until the heterodyne caused by the mixing of the BFO carrier with the AM signal's attenuated carrier is eliminated; fine tune the BFO within the heterodyne free zone until the audio is clarified. The audio distortion heard earlier at that frequency in the AM mode will now be absent. You have just achieved ECSS reception with the "old timey" technique. Switch back to the AM

mode and the distortion will reappear as you withdraw the "pinch hitting" BFO carrier. If in this experiment you could not eliminate the heterodyne, your BFO range is not great enough to achieve ECSS at that i.f. bandwidth. If you are using a vintage receiver like the R-390A, resetting the BFO control knob farther back on its shaft may free the control from a mechanical stop restricting the BFO range. With this trick you can increase the BFO range of the R-390A considerably beyond its normal 7 kHz. If this solution doesn't apply, you will not be able to attain ECSS reception with that bandwidth; switch to your next narrower i.f. bandwidth and start the experiment from the top.

The number of Hz you detuned the BFO from the i.f. to achieve audio clarity in the above experiment equals the number of Hz you detuned the receiver from the AM signal's carrier frequency. If, for example, you detune to 15067 from the BBC carrier on 15070 to produce audio distortion, then when you switch to the CW mode, you will have to tune the BFO to a frequency 3 kHz higher than the i.f. to eliminate the heterodyne and obtain audio clarity. This follows from the fact that in detuning from 15070 to 15067 you moved the 15070 carrier from the center of the i.f. passband, where its frequency equaled the i.f., to a position 3 kHz higher in the passband. To "pinch hit" for the attenuated AM carrier lying in the passband 3kHz above i.f., the BFO carrier injected at the detector must also have a frequency 3 kHz higher than i.f.

When we use the USB and LSB mode switches for ECSS, we reverse the above procedure: we offset the BFO carrier from the i.f. first; then we tune the receiver so as to place the AM carrier at the same position in the passband as occupied by the BFO carrier. Selecting LSB on the NRD-525, for example, activates the BFO at 456.5 kHz, precisely 1.5 kHz higher than the 455 kHz i.f. Therefore, I must tune 1.5 kHz below an AM signal's carrier to make the frequency of the AM signal's carrier, as it appears in the i.f. passband, equal to the preset bfo frequency. For true ECSS I must also select an i.f. filter which will attenuate by at least 6 db those frequencies 1.5 and more kHz from the receiver's frequency. Only then will the carrier and upper sideband component of the AM signal be sufficiently attenuated for true lower sideband ECSS. Given the 525's stock filters-the "wide" with its 6 kHz 6 db bandwidth and the "intermediate" with its 2.2 kHz 6 db bandwidth, the "intermediate" bandwidth is the only option. It attenuates by at least 6 db frequencies 1.1 kHz and more from the receiver frequency.

Given the "intermediate" filter's bandwidth, it is clear that using the "old timey" technique, ECSS reception can be attained detuned by as little as 1.1 kHz from the AM signal's carrier. Further, experiment will verify that ECSS reception can be obtained with the same bandwidth detuned from the the AM signal's carrier by as much as 2.1 kHz from the carrier frequency. Detuned by that amount you lose some of the bassier audio frequencies contained in those sideband frequencies lying closest to the AM carrier, but the gain in greater attenuation of a QRM source on the other side of the carrier may be worth the sacrifice. Audio becomes unusable when you detune from the carrier frequency by much more than 2.1 kHz with the "intermediate" bandwidth. I summarize this by saying that the "intermediate" bandwidth on the NRD-525 has an ECSS range between 1.1 and 2.1 kHz, meaning that with that bandwidth I can achieve ECSS reception using the "old timey" technique detuned from an AM signal's carrier by any number of Hz between 1.1 and 2.1 kHz. (See illustration at end of article)

Why be restricted by USB and LSB mode switches to detuning from the AM carrier by the same number of Hz in every situation? In some situations detuning by some other number of Hz within the selected bandwidth's ECSS range provides better QRM rejection or readability. "Old timey" ECSS technique allows you to do this. And in situations where one sideband of an AM signal is free of QRM, why settle for the narrow bandwidths required for ECSS reception with the USB and LSB mode switches? If your receiver's bfo range is wide enough, you can use a 6 or 8 kHz 6 db bandwidth and enjoy full range a.f. response. Detune your receiver from the AM signal's carrier frequency into the desired sideband half as many kHz as the selected i.f. filter's 6 db bandwidth. Turn on the BFO and proceed by the "old timey" technique. The only listening better than this on SWBC is phase locked, synchronous ECSS whereby the bfo carrier is phase locked to the attenuated AM carrier.

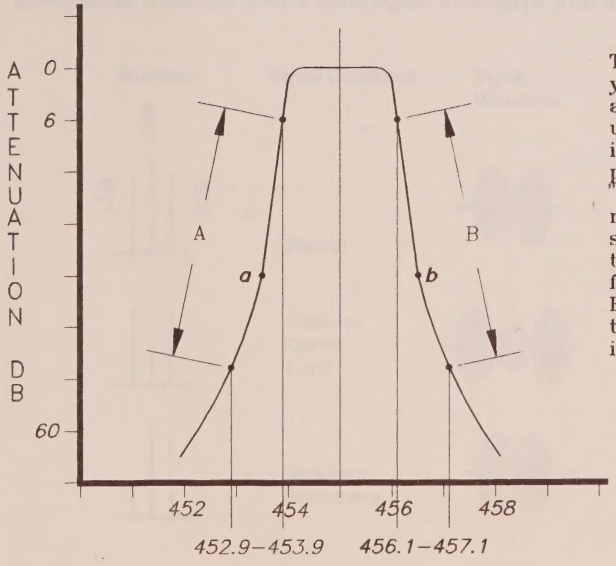
To become adept at the "old timey" ECSS technique and to determine at the same time the ECSS range for each of your receiver's i.f. voice bandwidths, the following procedure will work. Set your receiver for the AM mode and select an i.f. bandwidth for which you want to discover the ECSS range. Find a medium strength QRM free AM signal. Tune "nose on" to its carrier frequency. Then begin detuning in either direction from the signal's carrier frequency until the audio begins to distort as in the earlier experiment. The difference between the frequency at which the distortion begins and the signal's carrier frequency represents the lesser figure in the ECSS range for that bandwidth. Change to the CW mode and obtain ECSS reception by the "old timey" technique of synchronizing the BFO carrier with the AM carrier. You have obtained ECSS reception at the beginning of the ECSS range for that i.f. bandwith.

Remaining in the CW mode, begin detuning farther from the carrier frequency in very small increments (100 Hz or less), stopping at each increment and resynchronizing the BFO's carrier with the attenuated AM signal's carrier. If your receiver doesn't have a product detector, with a moderate to strong signal, as you slide the AM signal's carrier farther down the i.f. filter's response curve with your continued detuning, an audio distortion will begin to appear which you cannot correct by resynchronizing the BFO carrier with attenuated AM carrier. This distortion, due to detector overloading, is remedied by backing off the r.f. gain until the distortion disappears. I don't find the reduction of r.f. gain necessary on weak signals, so there is no sacrifice of maximum sensitivity when it is needed.

As you continue your incremental detuning and resynchronizing of the BFO carrier with the AM signal's carrier, you will reach a frequency at which the AM signal' s carrier is so attenuated it will no longer produce an audible heterodyne against the BFO carrier. At that frequency and beyond, it helps to switch temporarily to a wider i.f. bandwidth after each additional detuning increment. This step allows you to recover an audible heterodyne to assist you in resynchronizing the BFO's carrier with the AM signal's carrier. Once audio clarity is again achieved, switch back to the original i.f. bandwidth and make your next detuning increment. You will reach a frequency at which you will not have usable audio when you switch back to the original bandwidth. The frequency to which you tuned just before you reached this condition represents the end of the ECSS range for that bandwidth.

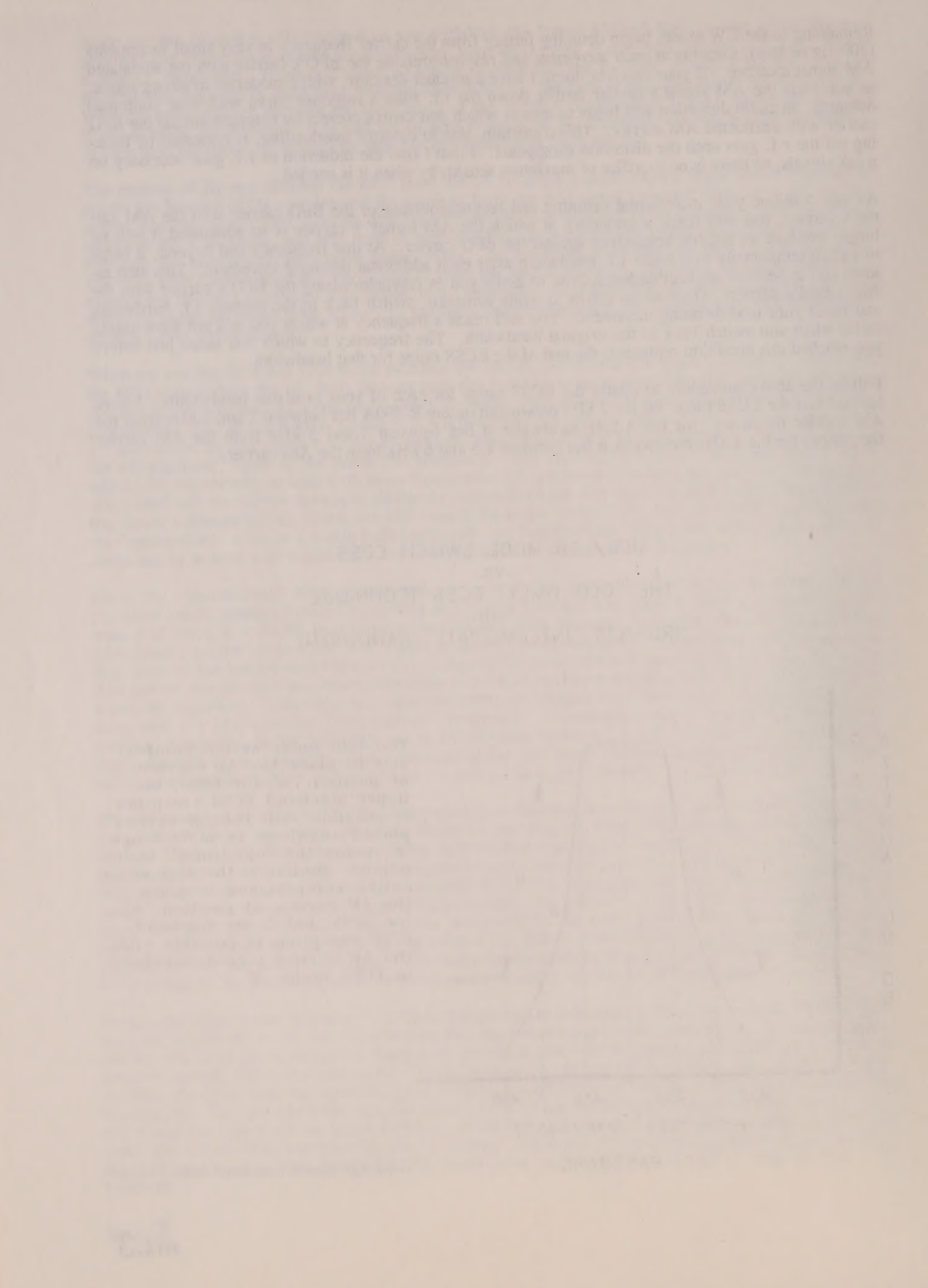
Follow the above procedure to obatin the ECSS range for each of your available bandwidths. I have learned that the ECSS range for the 2 kHz bandwidth on my R-390A lies between 1 and 2 kHz from the AM carrier frequency; for the 4 kHz bandwidth it lies between 2 and 3 kHz from the AM carrier frequency; for the 8 kHz bandwidth it lies between 4.5 and 6 kHz from the AM carrier.

USB/LSB MODE SWITCH ECSS
vs.
THE "OLD TIMEY" ECSS TECHNIQUE
with
NRD-525 "INTERMEDIATE" BANDWIDTH



The USB mode switch compels you to place the AM carrier at position "a" for ECSS, but upper sideband ECSS reception is possible with the AM carrier placed anywhere in ECSS range "A" using the "old timey" technique. Similarly, the LSB mode switch compels you to place the AM carrier at position "b" for ECSS, but lower sideband ECSS reception is possible with the AM carrier placed anywhere in ECSS range "B".

TYPIST JUDY SNYDER, ILLUSTRATOR RUSSELL SNYDER



SYNCHRONOUS DETECTION

Craig Siegenthaler

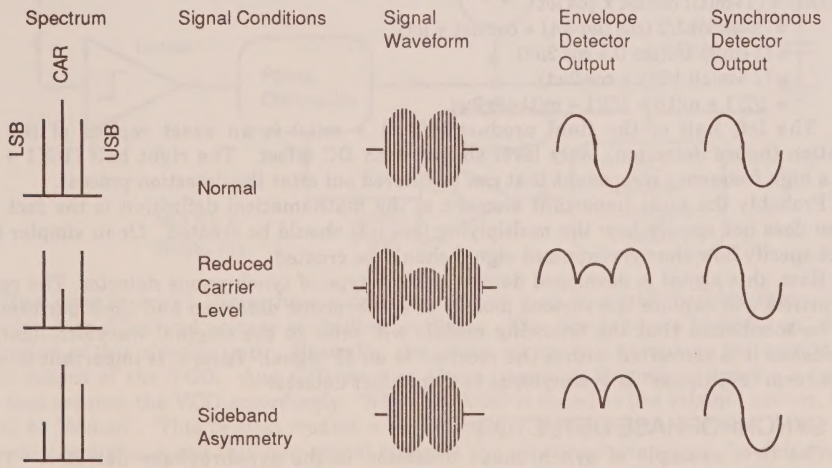
Radio signals are converted to audio at the detector. The detector is one of the most important elements of a receiver because it ultimately determines the sound quality. If the detector performs poorly, the audio will sound rough and edgy. When the detector can recover the audio exactly as received, the sound quality improves without introducing any additional distortion. Synchronous detectors are more nearly "ideal" detectors in performance than conventional detectors found in most receivers.

SYNCHRONOUS DETECTION VS. ENVELOPE DETECTION

The conventional AM detector found in all but a few receivers is called an envelope detector. It receives it's name by the way it strips the envelope or audio information from the carrier. The typical envelope detector is extremely simple, costs pennies to the manufacturer, and is usually nothing more than a germanium diode. The radio pioneers of the early twenties used a "cat's whisker" detector which is identical in performance to the germanium diode, and seventy years later, little has changed!

What's wrong with envelope detection? The most serious problems occur during multipath reception. This is a common occurance with shortwave signals as two different signal wavefronts arrive at the antenna with different phase characteristics. At one moment the signals might add, another moment they might subtract. This is one way that fading is created. The distortion resulting from a deep fade is a familiar sound to any shortwave listener.

During a fade, the balance between the audio (sidebands) and carrier is sometimes upset. The envelope detector creates severe intermodulation distortion when this balance is altered. An imbalance between the carrier and sidebands is a type of selective fading. Selective fading can also occur between the lower and upper sidebands which also creates distortion with the envelope detector. The following diagram shows the difference between envelope detection and synchronous detection with a radio signal modulated with an audio tone.



The benefits of using a synchronous detector are as follows:

1. It does not suffer from distortion when there is an imbalance between the carrier and sidebands.

2. It does not suffer from distortion when there is an imbalance between the upper and lower sidebands.

3. Using a synchronous detector will generally result in lower audio distortion compared to an envelope detector especially at the higher modulation levels.

These characteristics describe the "ideal" synchronous detector. There are numerous ways of creating synchronous detection and no one method is perfect. Each method has advantages and disadvantages but overall, the performance is significantly better than the envelope detector.

BASIC DEFINITION

What is synchronous detection? The Oxford American Dictionary defines synchronous as:1. existing or occurring at the same time. 2. operating at the same rate and simultaneously.

A synchronous detector is simply a detection process that uses a signal that is synchronous with the original carrier (occurring at the same rate or time).

For those interested, a better definition can be explained mathamatically ,where an AM monaural signal can be represented by the following[1].

$E(t) = (1 + m(t)) \cos wt$

In this equation the m(t) is the envelope or modulation and the cos wt is the carrier.

An analog synchronous detector is a multiplier whereby the original AM waveform is multiplied by a signal that has the same frequency and phase characteristics as that of the carrier.

It's that simple. Mathamatically, this is represented by[1]:

Detector Output $D(t) = (1+m(t)) \cos wt \times \cos wt$

Note that the original waveform is multiplied by cos wt. Now if the multiplying cos wt is identical with the original carrier, (same frequency and phase characteristics) the equation results in[1]:

$D(t) = (1+m(t)) \cos wt \times \cos wt$

$= (1+m(t))\ 1/2\ (\cos (wt-wt) + \cos (wt + wt))$

$= (1+m(t)\ 1/2(\cos 0 + \cos 2wt)$

$= (1 +m(t))\ 1/2(1 + \cos 2wt)$

$= \underline{1/2(1 + m(t))} + \underline{1/2(1 + m(t) \cos 2wt}$

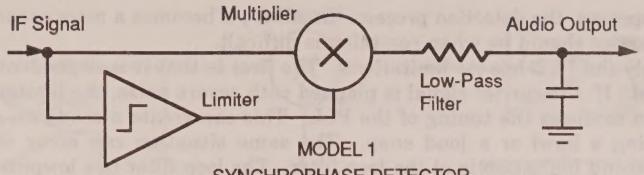
The left half of the final product (1/2 (1 + m(t)) is an exact replica of the original modulation (hence detection), only level shifted with DC offset. The right half (1/2(1 + m(t) cos 2wt) is a high frequency component that can be filtered out after the detection process.

Probably the most important element of the mathamatical definition is the fact that the equation does not specify how the multiplying (cos wt) should be created. Or in simpler terms, it does not specify how the synchronized signal should be created.

How this signal is developed determines the type of synchronous detector. The remainder of this article will explore the various models of synchronous detection and their performance. It should be mentioned that the following models will refer to the original waveform (carrier and sidebands) as it is converted within the receiver to an IF signal. Also, it is important to point out that the term "multiplier" is synonymous to a "product detector".

SYNCHROPHASE DETECTOR

The first example of synchronous detection is the synchrophase detector. The term "synchro-phase" was used by Drake with the introduction of the R-7 receiver. A similar detector is now used in the Japan Radio NRD-525 receiver.



MODEL 1
SYNCHROPHASE DETECTOR

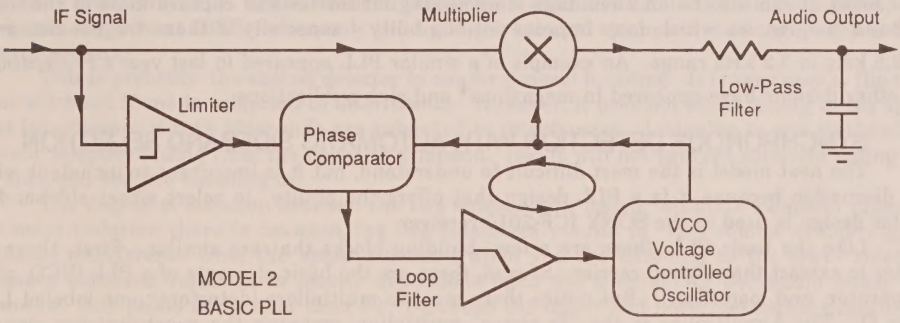
The basic building blocks of a synchrophase detector are the limiter and multiplier. The limiter is a high gain amplifier that removes the audio from the input signal, leaving only the carrier. The multiplier is the actual detector where the original waveform is multiplied (or detected) by the synchronizing signal (output of the limiter). The output of the multiplier is audio mixed with a high frequency component which the lowpass filter removes. It should be made clear that this type of detector is true synchronous detection. It models the mathematical definition perfectly, since the original waveform is multiplied by it's own carrier.

The main problem with this detector occurs during severe selective carrier fading or when the carrier fades into the noise. Under these conditions, there is insufficient carrier level and no amount of limiting will properly extract the carrier signal.

An improved synchrophase detector has been developed by KIWA Electronics. This detector is designed for low level signal detection and is a feature of the **M**ultiband **A**m **P**ickup or **MAP**. The **MAP** uses a process of regenerative carrier feedback to improve the detector's performance during selective carrier fading or when the carrier is subjected to noise. In field tests with the NRD-525, the **MAP**'s detector was able to extract weak audio from DX signals where the original receiver's detector was only able to extract noise[6].

BASIC PHASE LOCKED LOOP

The next model is a basic phase locked loop design. As with the synchro-phase detector, there is a limiter to extract the original carrier, and a multiplier. The elements of the phase locked loop consist of the VCO-voltage controlled oscillator, the phase comparator, and the loop filter.



MODEL 2
BASIC PLL

How does it work? Notice how a circular path or loop is established between the phase comparator, loop filter and voltage controlled oscillator. The name "phase locked loop" describes the operation of this circular path. Basically, the phase comparator compares the original carrier with the output of the VCO. Any difference in phase (meaning frequency) creates a correction voltage that retunes the VCO accordingly. When the VCO is tuned to the original carrier, the PLL is said to be "locked". This process creates a second carrier signal that is identical to the original in frequency and phase and this new signal becomes the synchronizing signal for detection. It is important to point out that the PLL only generates the second carrier. Detection still takes place in the multiplier, as in the first example.

Why generate a second carrier? The original is often plagued by noise and a simple limiter as in Model 1 will not remove the noise adequately. The second carrier is for the most part

noise free, which improves the detection process. In effect , it becomes a more accurate example of what the original carrier should be when reception is difficult.

Unfortunately the PLL has its limitations. The first is that it is dependent on the limiter for the carrier signal. If the carrier signal is plagued with severe noise, the limiter will also have noise which in turn confuses the tuning of the PLL. This can create a condition where the PLL will "unlock" creating a howl or a loud snap. The same situation can occur with co-channel interference. The second limitation is at the loop filter. The loop filter is a lowpass filter which is necessary to slow the tuning of the PLL. Without it, the PLL would try to retune with impulse noise. A properly designed loop filter will provide short term memory, holding the VCO's frequency and phase characteristics when subjected to interference from impulse noise or if the carrier level momentarily drops into the noise. The advantage of using a loop filter with memory becomes a disadvantage when one considers propagation. A shortwave signal seldom arrives at the antenna from the same direction. The changes in propagation means the carrier phase characteristics are changing from one instant to the next. If the PLL is slow to retune to these phase changes, it will create artificial fading. (This condition occurs when the carrier and VCO phase characteristics differ by 90° or 270°.) It is interesting to note that portables using the basic PLL detector with a short whip antenna would exhibit less of this problem than receivers with a similar detector and using a wire antenna that can effectively capture several signal wavefronts[2].

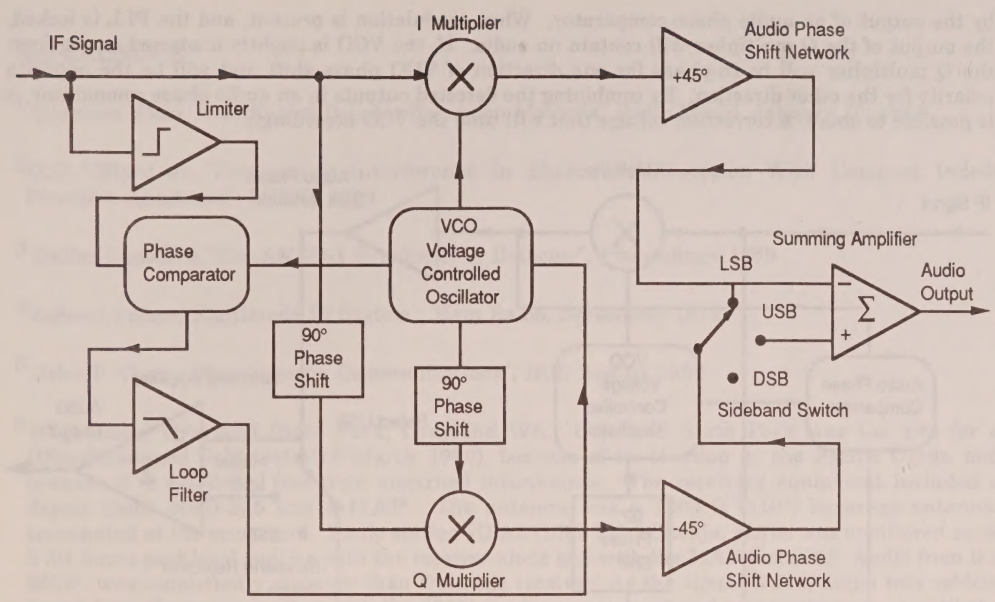
The advantage of using this type of PLL and for that matter the synchrophase detector, is that it is possible to offset tune the receiver. That is, the receiver can be tuned above or below the carrier frequency to favor one sideband. As long as the carrier is within the passband established by the IF filters, synchronous detection is possible. With proper choice of IF bandwidths, these basic detectors will allow synchronous detection of nearly the entire upper or lower sideband or somewhere in between. This has definite advantages to the DX'er, since the receiver can be tuned to the exact spot of least interference. Tuning to one sideband will reduce selective fading from the opposite sideband. The degree of isolation between the sidebands is determined by the IF filter response. Sharper filters (filters with good shape factors) will provide better isolation between the sidebands. The disadvantage of using this tuning scheme is that the audio frequency response suffers when the receiver is tuned off center frequency. This is the result of phase differences between the sidebands, established by the IF filters and combined in the detection process. On the other hand, it can also be an advantage since tuning off carrier will capture more of the higher sideband frequencies which may improve intelligibility - especially if these frequencies are in the 2.5 kHz to 3.2 kHz range. An example of a similar PLL appeared in last year's *Proceedings* [3] and other designs have appeared in magazines[4] and club publications.

SYNCHRONOUS DETECTION WITH AUTOMATIC SIDEBAND SELECTION

The next model is the most difficult to understand, but it is important to include it within this discussion because it is a PLL design that offers the ability to select either sideband. A similar design is used in the SONY ICF-2010 receiver.

Like the basic PLL, there are a few building blocks that are similar. First, there is a limiter to extract the original carrier. Second, there are the basic elements of a PLL (VCO, phase comparator, and loop filter). But notice there are two multipliers (detectors); one labeled I, the other Q. The I multiplier is the "In-phase" multiplier, meaning the synchronizing signal is "in-phase" with the original carrier. The Q multiplier is the "quadrature multiplier", meaning the synchronizing signal is "in-quadrature" or phase shifted 90° from the original carrier. This phase shift is established by the 90° phase shift network. It is important to note that the Q multiplier used in this detector has no relationship to the Q Multiplier used in receivers to enhance the selectivity of an IF circuit.

The output of the I multiplier is detected audio, in-phase with the original signal. The output of the Q multiplier is detected audio that exhibits a 90° phase shift difference. Both multiplier outputs enter all pass audio phase shift networks.



MODEL 3

PLL WITH SELECTABLE SIDEBANDS

In the example shown, the in-phase audio is phase shifted +45°, the Q audio is phase shifted -45°. The total phase shift difference between the I and Q signal paths now totals 180°. The established 180° phase difference between the two audio signals allows sideband selection when combined in a summing amplifier. As shown, the switch in the upper position will select the lower sideband - LSB. The USB - upper sideband is selected with the switch in the middle position. Both sidebands are present (DSB) when only the I audio is selected as shown when the switch is in the lower position.

This is probably the easiest detector to use for general listening. It is very easy to flip to the other sideband if one is subjected to interference. However, it does not allow tuning to the spot of least interference if both sidebands are subjected to interference. Listening to one sideband will prevent selective fading from the opposite sideband. But it will not prevent selective fading from the sideband you are listening to.

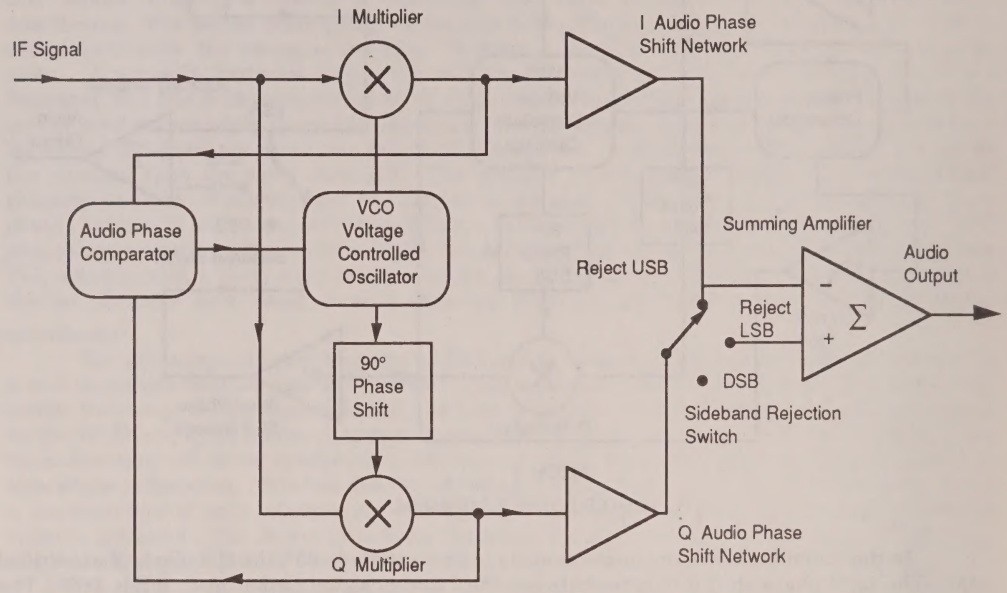
The degree of isolation between the two sidebands is called "ultimate sideband rejection". The more isolation there is between the two sidebands results in less chance of hearing, for instance, interference from the upper sideband when you are listening to the lower sideband. Ultimate sideband rejection is mostly dependent upon the accuracy of the audio phase shift networks. Any phase shift other than 90° (between the upper and lower networks) degrades the ultimate sideband rejection. A design using high quality precision components can exhibit sideband rejection of more than 30 dB. Most manufacturers settle for less exact components resulting in sideband rejections that are less than optimum.

The other detector models can often exhibit better sideband rejection when they are used with offset tuning. Mediocre IF filters can reject signals outside their passband with more than 30 dB rejection. It should also be mentioned that the selectable sideband PLL detector does not exhibit the problems of "artificial fading" as with the basic PLL.

SYNCHRONOUS DETECTION WITHOUT THE CARRIER

This model has been included because it establishes a PLL synchronous detector without reference to the carrier (contrary to published information)[5]. The design uses a VCO that is tuned

by the output of an audio phase comparator. When modulation is present, and the PLL is locked, the output of the Q multiplier will contain no audio. If the VCO is slightly mistuned, audio from the Q multiplier will be in-phase for one direction of VCO phase shift and will be the opposite polarity for the other direction. By combining the detected outputs in an audio phase comparator, it is possible to obtain a correction voltage that will tune the VCO accordingly.



MODEL 4
PLL WITHOUT CARRIER REFERENCE

This type of detector requires audio for the PLL to lock. Once audio is absent (the announcer stops talking), the PLL goes out of lock. Lock-up response time will be determined by how far the VCO is mistuned and by the response time of the audio phase comparator.

This detector offers advantages over other models that are referenced to the carrier. This is especially true during selective carrier fading. In fact, this model will perform with DSB signals that have suppressed or no carrier.

SUMMARY

These are just a few of the ways synchronous detection can be created. All of them are dependent upon extracting some element of information from the original signal for the detection process. This automatically imposes limitations as to how the detector will perform when subjected to different types of propagation, signal strength and interference.

What is the best detector? For general listening, the selectable sideband PLL detector is excellent. But for DXing, the PLL may not be the best choice. Their tendency to un-lock with weak signals makes them difficult if not impossible to use. A synchronous detector that only extracts the original carrier for detection will out perform the PLL under weak signal conditions.

The radio enthusiast should be aware of the various types of synchronous detection available, especially if planning to purchase a new receiver or any other device that offers synchronous detection. Remember, not all synchronous detectors are the same!

REFERENCES

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[2] O.G. Villard Jr.,"Combatting Interference In Shortwave Reception With Compact Indoor Directive Antennas", WRTH 1990

[3] Dallas Lankford,"The AMSD-1 Synchronous Detector", Proceedings 1989

[4] Richard Factor,"Multimode IF System", Ham Radio, September 1971

[5] John P. Costas,"Synchronous Communications", IRE, August 1956

[6] DXpedition, Grayland State Park, Grayland WA. Grayland State Park was the site for a DXpedition and field tests (18 March 1990), because of its location at the Pacific Ocean and because it is relatively free from electrical interference. The receiving equipment included a Japan Radio NRD-525 and a **MAP**. The antenna was a 1200 ft (310°) beverage antenna, terminated at the ocean end. Radio station HLAZ (1566 kHz) Chenju, Korea was monitored up to 2 3/4 hours past local sunrise with the receiver alone and with the **MAP** installed. Audio from the **MAP** was consistently stronger than from the receiver. As the signal faded, audio was seldom heard from the receiver. But with the **MAP**, audio was present and was monitored up until the station faded into the noise. This observation was confirmed by several members of the DXpedition.

A REVIEW OF THE KENWOOD R-5000

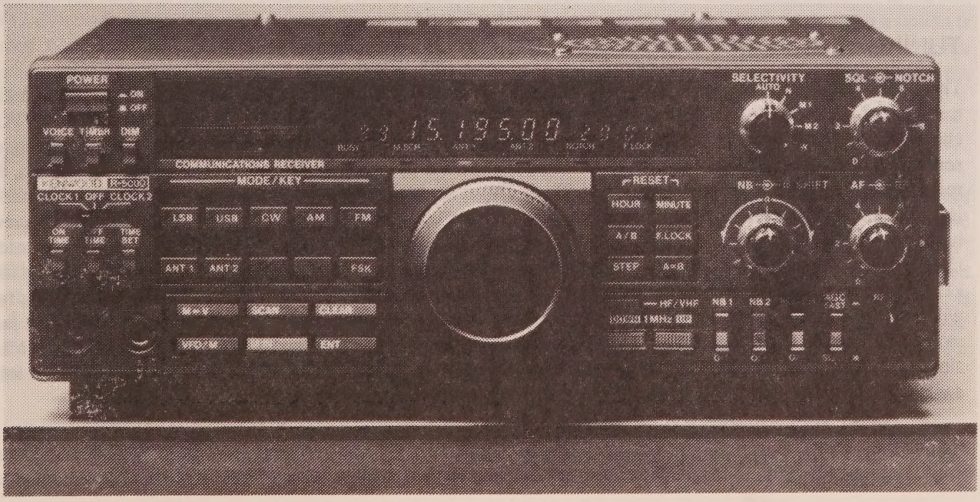
By Don Moore
With Technical Comments by Kent Willis

Why choose a Kenwood R-5000? Among the three current top-of-the-line communications receivers (ICOM R-71A, JRC NRD-525, and the R-5000), the Kenwood seems to be the least used by North American DXers, if DX club contributors lists are any indication. Two years ago, when I realized I would soon be financially able to buy a replacement for my hardy FRG-7, I decided to carefully look over the three choices. Whichever I chose would be my main receiver for at least five or six years. I quickly dropped the ICOM from consideration when ICOM had to drop passband tuning from the receiver. Of the remaining two, I tried each of them out in showroom conditions, and pored over everything I could find on them, especially Larry Magne's White Papers. Principally based on Magne's writings, I came to the conclusion that, with their own relative pluses and minuses, the R-5000 and NRD-525 were equal as DX receivers. The Kenwood, however, had two important advantages. First, it was reputed to have superb audio quality. Secondly, the stock model was $350 cheaper than the NRD-525.

After moving and settling into a new home in Michigan, I finally got the receiver in August, 1989. Since then, I've given it almost a year of very heavy use. Dual VFOs, memories, and stable easy-to-use ECSSB reception (that doesn't offset frequency when switching between USB/LSB) have revolutionized my DXing, and added a lot of stations to my totals. The excellent audio has made listening to DX more enjoyable than ever before. The R-5000 is not perfect, but its drawbacks are minor. In short, I believe I chose the right receiver for me, and I believe more DXers should consider it when purchasing a top-notch communications rig. So, let's take a in-depth look at the R-5000.

SOME BASIC OBSERVATIONS

In my view, the R-5000's crisp and clean audio section is its shining star. After all, it doesn't matter what the rest of the receiver does if the end product isn't easy to understand—especially when trying to pick out IDs in foreign languages. There is practically no hiss or other background noise like so many other receivers I've tried. I like the R-5000 audio so much, that I still haven't gotten around to hooking it up to my graphic equalizer. Still, it wouldn't be a bad idea, since Kenwood neglected to put a tone control on the R-5000. There is an audio notch filter deep



enough to eliminate most hets. The notch helps in pulling weak signal audio out of the mud.

The R-5000 is a very sensitive receiver; I have been impressed with how well it handles weak signals. When sharing tips via phone with other DXers, I have been amazed at how much better I am hearing a particular station. What's more, the audio section makes weak signals readable. If no major QRM/QRN is present, an S-1 signal can be made 50-60% readable with a little tweaking of the controls. That has helped me ID a number of otherwise hopelessly weak signals, such as Latin harmonics and 100 milliwatt MedFER beacons on the 1600 khz band. For example, last New Year's Eve I was tuning through the 2 MHz band, looking for harmonics. There seemed to be audio on 2060, but it was hard to tell with a ute just above the frequency. I was already on the 2.4 khz filter, so I switched from AM to LSB. The interference was gone, but the signal was still a bit muddy. A little adjustment of the notch filter and I could understand most of what the announcer was saying, despite a signal strength that barely budged the S-meter. The station turned out to be the harmonic of an Ecuadorian MW station. I called up a DX friend a few hundred miles away, and tuning in he agreed there was some sort of weak signal there, but couldn't get any usable audio out of it.

Like most modern communications receivers, sensitivity is intentionally reduced on the MW broadcast band. I find that frustrating, since I live in a rural area without nearby high power stations. Overall MW reception seems weak when using a wire antenna, such as a beverage. I believe that some firms modify the R-5000 so that the better SW sensitivity also works on MW. I will eventually have that done. At least in rural locations, the receiver's three step attentuator should be adequate for any overloading problems.

> "Excellent sensitivity is maintained through very low noise design. A review of the complete schematic indicates very careful selection of all discrete semiconductors, especially diodes, and FETs. The RF amplifier, mixer preamplifier, first mixer, mixer postamplifier, and voltage controlled oscillators (which provide inputs to the mixer from the VFO) use only low-noise FETs as opposed to ordinary bipolar junction transistors. Front end selectivity is achieved through a parallel combination of 10 separate bandpass filters which greatly reduce overloading. For a given frequency range, the design of the bandpass filters permit only a minimal amount of out of band signal energy from reaching the RF amplifier, maintaining the high overall image rejection.
>
> "Don has mentioned the intentionally reduced AM sensitivity for the BCB, listed as less than 32 microvolts for the 500 khz to 1.8 MHz range in most advertising literature (the service manual claims 16 microvolts). Many solid state receivers have difficulty handling bonecrushing AM BCB signals which are often present when listeners live near 50 kw transmitters. Reducing sensitivity certainly will help to prevent overloading, but there is much more to strong signal handling capability than sensitivity reduction. The 10 to 30 dB attenuator should prevent overloading under virtually all conditions. " (Willis)

TUNING

There are several ways to tune the R-5000. First, there is the old-fashioned "big round knob" in the center, which I use most of the time. It has a good smooth "feel" to it, and the "drag" is easily adjusted. There are dual VFOs, chosen by an "A/B" button. An "A=B" button makes it easy to temporarily save a frequency while checking on something else. Readout is to the nearest 10 Hz, but is varied by a "step" control. With the step control on, the receiver tunes in 100 Hz increments in AM, SSB, & CW at about 50 kHz per dial revolution. With step off, it tunes in 1 kHz increments in AM at 20kHz per revolution and 10 Hz ones in SSB/CW at 10kHz per revolution. Because tuning is via digital steps, it is not possible to tune any finer than within 10 Hz. Generally I keep step on, unless fine-tuning in SSB. In AM, I find the 20 kHz per revolution tuning rate to be annoyingly slow when tuning in 1 kHz increments. If the dial is spun fast enough (3 revolutions per second according to Kenwood) the tuning rate will increase geometrically in accordance to dial rotation speed. I'm not sure if it's possible turn the knob that fast, since it lacks a finger dimple. Fast tuning up and down the band is also accomplished by plus/minus 1 MHz slewing buttons, which may be held down until the desired MHz frequency is reached. Sometimes I wish that were switchable to plus/minus 100 kHz, but I know of no receivers which offer that feature.

Tuning may also be accomplished by direct keypad entry. The multi-function keypad serves for direct frequency entry, and as push buttons for mode change and antenna choice. The default position is for mode and antennas,

which means before entering a frequency, one must push the "ent" button, telling the receiver that modes are not being switched. In practice, this is simple, quickly learned, and no problem. The R-5000 keypad is, however, annoying in two ways. First, initial zeros must be entered. For example, to keypad tune 4975 kHz, one must hit "Ent-0-4-9-7-5-0-0". Trailing zeros do not need to be entered, if one rehits the enter button instead, e.g. "Ent-0-4-9-7-5-Ent". When I want to go from 60 to 90 meters, I usually hit "Ent-0-3-3-Ent" for 3300 khz. With keypad entry to the nearest 10Hz, I see why all these extra zeros are necessary. If the R-5000 used a floating decimal, like Sony receivers, I would complain about having to punch in the trailing two zeros after the decimal point. However, I think everything would be simpler and just as useful if keypad tuning was with a floating decimal, but only to the nearest 1 kHz. Anything finer than that is easily done by hand. The second annoyance of the keypad is the arrangement of the numbers in a "2x5" bank. That is, there is a row of keys numbered 1-5 over a row of keys numbered 6-0. Punching in a frequency like 2060 or 4607 Khz requires a lot of back and forth finger movement. This arrangement seems to be harder to learn than the more standard 3x3+1. I still can't accurately punch in a frequency without looking at the keypad. Still, despite these annoyances, I find keypad entry useful and usable in checking out specific frequencies. Also, when going from 5 to 15 MHz, it is a lot faster than using the slew buttons.

The keypad is also used in setting and selecting the R-5000's 100 memory channels. This is less than some other receivers, but I have yet to need them all. I use about 50 for DX frequencies, about 20 for working memories, and a few for WWV and RCI. Each channel saves the exact frequency, mode, and antenna choice. To use a memory channel, first the "VFO/M" button is pushed. This switches the receiver from the current VFO to whatever the last memory channel used was. Pushing it again will bring back the VFO.

Once in memory mode, memory channels are easily selected by one of three methods. To get to a specific channel, the actual memory number, e.g. 54, may be entered in the keypad. Alternatively, the entire memory bank, or a portion of it, may be "tuned" by turning the main tuning knob. Similarly, in memory mode the 1 MHz up/down slewing buttons instead tune up and down through the memory channels. Either method is very useful for quickly checking out a select group of scattered frequencies. For example, I keep a number of evening Bolivian frequencies in the 50s range, and a sample group of Indos in the 40s range. It is also possible to use either of these methods to scroll through the memories while listening to something else via the VFO circuit. As Larry Magne points out in his review, the R-5000's memories are not tunable. However, that is no big deal. They become tunable by pushing the M>V button which transfers the memory data to the current VFO, switching to VFO mode at the same time. I use that method a lot of times to get to 60 meters, going via my 5MHz WWV memory.

The R-5000 has a scanning function, which can either scan preset banks of ten memory channels or a set range of frequencies. Although scanning is generally not useful on SW, I thought it might be nice in listening to 2 MHz Coast Guard channels, where stations go on and off a lot like VHF/UHF stations. However, the scanner stops at each scanned channel for a full 5 seconds, taking almost a minute to go through a bank of 10 memories. A quick message can take less than half that time. When a station is encountered, scan still automatically goes on at the end of five seconds. Universal offers a carrier option that will allow the scanner to stop on a frequency when a station is heard, but I don't believe it will speed up the scanner. I didn't get the option because it requires use of the dimmer switch, which I wanted to keep. Perhaps the modification could use the nearby voice switch instead (unless the optional voice synthesizer unit is added).

SELECTIVITY

The stock R-5000 comes with two filters, a 6 khz AM filter and a 2.4 khz "wide" SSB/"narrow" AM filter, and accomodates a total of four. According to Magne, the wide filter's skirt selectivity is "disgraceful", while the narrow one is quite good. Kenwood offers two optional voice bandwidth filters, at 6 kHz and 1.8 kHz for "narrow" SSB and AM, as well as several very narrow CW filters. Universal (and maybe some other dealers) offers an optional 4 khz filter. According to Magne, these are good to excellent. What really gladens the heart of the DXer is that all filters are individually selectable in any mode. No being forced to use SSB in order to use a narrow filter. Alternately, the filters may be switched to "auto", which automatically uses the wide filter for AM, the 2.4 kHz for SSB, and any narrower one for CW.

> "One of the most impressive features of the R-5000 is the IF filter circuitry. Many receivers with multiple bandwidth selection have a parallel filter arrangement. After passing through a mixer, the signal at the IF frequency enters only the selected filter of the desired bandwidth without

passing through any other wider or narrower filters. In contrast, the R-5000 employs a series (cascaded) filter arrangement. For example, if we have selected the 2.4 khz bandwidth, the mixer output signal would have first passed through the 6 khz filter. The wider filter(s) ahead of the final selected filter passes the signal with essentially no attentuation. This "prefiltering" introduces a negligible time delay, but no other undesirable side effects. The advantage of such a scheme is increased attentuation of inteference outside of the selected filter passband. This is how Kenwood achieves the very high guaranteed minimum attentuation of 80 dB, for example, within about 10 khz of the received frequency with the optional YK-88A-1 6 khz AM filter. With a little circuit board "chop and swap" and manipulation of some programming jumper wires, just about any cascaded filter combination is possible.

"No mechanical AM filters are available for the Kenwood because of the very high and unique second IF frequency of 8.830 MHz. Communication receivers that either contain or accommodate mechanical filters use a 500 khz or lower (typically 455 khz) last IF frequency. There are no mechanical filters for such high frequencies. Mechanical filtes with a center frequency higher than about 1 MHz can not be produced with existing technology." (Willis)

When I purchased my R-5000, I hoped to get the stock wide filter replaced with Kenwood's 6 khz filter, and add the 4 khz and 1.8 khz filters to fill in the four slots. Unfortunately, because of the technical arrangement of the filters, at that time Universal could not put in both the 6 khz and 4 khz filters. Each could only go in the emptied 6 khz slot. Being primarily a DXer, I choose the narrow 4 khz filter, leaving me with three selectivity options. The 6 khz filter would probably have been better for general SWL use. I am glad I choose the 4 khz filter. I was worried that it would be too narrow to adequately appreciate the Kenwood's superb audio quality in the general listening that I do. To the contrary, it is as pleasant to listen to as is my Sony. Moreover, because it is relatively narrow, it is usuable in real DX situations. Even listening to very weak signals is enjoyable, if they arefree enough of QRM to use this filter. The 4 khz filter is a good choice for the serious DXer who doesn't do a lot of SWLing. Still, I'm sure the 6 khz filter would be better yet for general listening, and wish I had been able to add it. Universal has recently been supplied with some new technical data, showing how both the 6 khz and 4 khz filters could be added. I know they have done this to at least one receiver.

The 2.4 khz filter does a great job of eliminating nearby QRM. With it, I can listen to Radio Reloj on 4832 with hardly a trace of QRM from Tachira on 4830 and Tezulutlan on 4835. What's more, the audio quality is still pleasant to listen to, and very understandable. The 1.8 khz filter performs similarly well. However, in my opinion, it is redundant. The differance between it and the 2.4 filter is minimal. What is gained in selectivity is lost in the less listenable narrower audio bandwidth. In seven months of use, I have found only one or two cases of SWBC DX where the 1.8 khz filter made a significant positive differance over the 2.4 khz one. I'm so hardboiled that I don't believe that's worth eighty bucks. Even in SSB ute DXing, I haven't found the 1.9 khz filter particularly useful. I wish now that I would have gotten a CW filter instead.

In sum, the best arrangement would be to replace the stock 6 khz filter with the optional 6 khz one, and add a 4 khz filter. Serious DXers who want to keep the cost down a bit, could consider just getting the 4 khz filter. Those with an interest in CW may want a narrow CW filter.

"Pass-band tuning is accomplished through circuitry which permits shifting of the IF passband approximately +/- 1 khz without changing receiver center frequency. The fact that you can shift the IF passband by almost 2 khz with rapid attentuation is proof of the very steep skirt of the overall IF passband fltering circuit. The audio response will also shift from a highpass to lowpass mode as this control is rotated. Unfortunately the stock model does not permit using this very powerful inteference reducing technique in the AM or FM modes. Of course, utility and SWBC DXers who use ECSSB techniques will love this feature. " (Willis)

CONTROLS AND MORE

When Theresa first saw my new R-5000 unpacked and setting on my desk, her first comment was "Oh, it's cute!" She always thought my large, clunky, utilitarian FRG-7 was ugly. The bright display colors and compact size may give the R-5000 a certain cuteness, but that doesn't mean it's not solidly built. Not only does it "feel" solid, but

Universal told me that, excluding non-receiver fault problems like power surges, they get fewer R-5000s back for repairs than anything else they sell.

> "The mechanical packaging is impressive. It contains separate removable and replaceable printed circuit board subassemblies for each of the major units including the RF, IF, PLL and switching control modules. Such a design simplifies fault isolation and repair and contributes to the very high degree of reliability attested to by several major SW equipment dealers. Consequently, malfunctions should be few, but when they do occur, repair costs will be reasonable." (Willis)

Unfortunately, that solidly-built compact size also contributes to the R-5000's most serious drawback: most of the controls are small and closely spaced together. I have long narrow fingers, yet still occasionally hit the wrong button, or grab the wrong ring on the two-function concentric knobs. DXers with large "ham" hands may well want to try out an R-5000 before purchase. But, one can't complain about the convenience of what all these fancy buttons and knobs do.

Under the frequency display there is a series of small lights which indicate whether various functions, such as the notch filter, are being used. These are very useful in remembering to turn off or switch functions. One of my little pet peeves with the R-5000, however, is that there is no indicator light to remind the user when the IF shift is engaged. Thus, after using it to flush out some rare DX, I frequently go about bandscanning with the IF shift off center.

The R-5000 comes with two adjustable noise-blankers. The first one is for pulse noises, such as ignition. I occasionally get a pulse-type noise on the tropical bands in the evening from a neighbor. I push the button and it's gone. I've never even had to adjust it. The second noise-blanker is for dealing with the "woodpecker". I haven't yet had to try this one, since I do most of my listening in the tropical bands. The R-5000 includes a clock, or actually two clocks which share the same display. The two clocks are chosen via a slide switch; a third position is "off", with no clock displayed. Unlike, for example, the NRD-525, the clock does not share display with the frequency. If the receiver is turned off, the clock is still displayed until either the clock is switched off or the receiver unplugged. On the negative side, the clock, however, does not display seconds. Clock one can be used to turn both the receiver and an outboard taperecorder on and off. I have yet to use this function, but believe it will only control a taperecorder via the DC remote control jack, unlike, for example the old FRG-7000 that controled via the AC plug. This makes it impossible to remote record with a stereo tape deck.

When the receiver is unplugged, the clock and memory channels are kept alive by a built-in rechargeable NiCad battery. Kenwood says a full charge should last about ten days. A fanatic about lightning protection, I normally unplug the receiver when not in use, yet I have had no problem in keeping the charge up. The receiver even kept its charge despite being unplugged for a month while I was out of the country. Note that the acutal software that runs the receiver is permanent, so no worries like with the ICOM R-71A!

Two seperate antenna hookups on the rear allow for some antenna flexibility. Hookup one is a coax jack for a balanced input. Hookup two allows either a 50 or 500 Ohm unbalanced hookup. I connect various outdoor antennas via a B&W switch to the coax input, and my ferrite loop to the unbalanced connection. Antennas are switched via two of the keypad buttons. There are two dial indicator lights which display which is currently in use. There are jacks on the front panel for headphones (1/4") and a taperecorder (1/8"). The tape level is just right for both my cheapo Radio Shack recorder and my old Technics cassette deck. There is a 1/8" jack on the rear of the receiver for attaching a seperate speaker. The inboard speaker is in the top of the receiver, so sounds a bit muffled, especialy with a shelf just three inches above it. Kenwood sells an optional speaker, but I bought a Radio Shack Miinimus-7 on sale, which sounds fine.

> "I use an external speaker with an Autek QF-1A audio filer. The QF-1A is used to satisfy the minimum power input requirements of my Realistic Minimus-3.5 speaker as well as compensate somewhat for the different frequency response of my external speaker. The optional matching speaker for the R-5000 has only one advantage in my opinion. It matches. In my opinion, it sounds worse than the internal top-mounted speaker and isn't worth $65. I recommend an external high efficiency speaker with good mid and high frequency response. The R-5000 can

supply approximately 1.5 watts into a nominal 8 ohm load, but you could connect anything with a 4 to 16 ohm impedance with a corresponding power loss due to the impedance mismatch. The compact size, top mounted speaker, optional under dash mounting bracket and 12 VDC input capability all indicate the R-5000 is well suited for mobile applications." (Willis)

Optional RS-232C interfaces are available for connections between the R-5000 and a personal computer. Several companies offer software control programs designed for IBM-PC/compatible machines as well as Apple Macintosh computers which can control the receiver.

Finally, the R-5000 comes with a detailed manual that clearly explains everything there is to know about operating the receiver. I believe in reading and following the instructions on anything I buy, and have high standards on how an instruction manual should teach the reader. The R-5000 manual is the only set of instructions that I've seen in years where I haven't ended up cussing out the writers. Kenwood should give classes in instruction writing to other companies!

CONCLUSION

The R-5000 is a good choice for the serious DXer, especially if he/she also wants to enjoy great audio. I enjoy listening to it so much, that I probably spend more time DXing than I would otherwise. A new R-5000 is a bargain for about $1000 with two added filters. Anyone looking for a new receiver and who expects value for their money should give the R-5000 strong consideration.

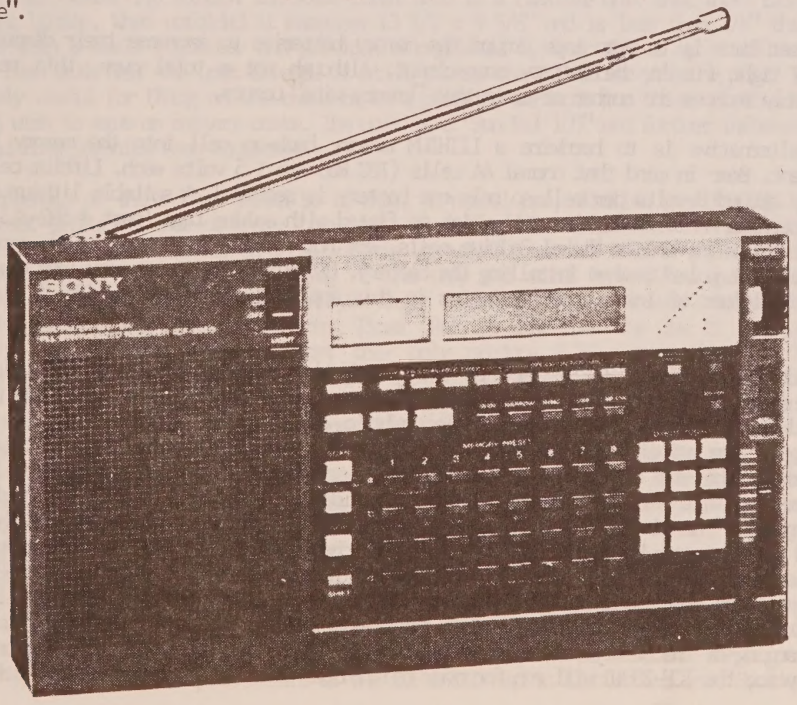
MODIFYING THE SONY ICF-2010/2001D

A Compendium

Gordon Darling

THE ULTIMATE PORTABLE?

When I first started DXing, many more years ago than I care to remember, second hand (usually WW2 surplus) equipment was the order of the day. DXing on holiday or while lazing on the beach was impossible. The equipment was bulky, ran from hefty mains power supplies and had inaccurate analogue frequency readout. In short, it was neither easy to use nor portable. However in the seventies things began to change for the better. This "change" was the gradual availability of reasonably portable receivers and, if not digital, at least accurate analogue frequency readout. The Barlow-Wadley XCR-30 (released 1972) and the SONY ICF-5900W (1979) are obvious examples of this first generation of quality portables. The next development was the affordable, true digital-readout portable receiver the SONY ICF-2001. Since then other manufacturers have followed SONY's lead, some with notably less success than others. Late in 1984 SONY released the ICF-2001D (or ICF-2010 in the US market). In some respects this portable was a quantum leap ahead in consumer technology with its synchronous detection and other advanced features. Even now, six years after its release, the ICF-2001D has very little competition. Not even Grundig's Satellit 500 is threatening SONY's niche in the market. With minimal competition from rival manufacturers SONY has virtually no incentive to bring out a replacement and both SONY Australia and SONY Japan deny a replacement for the ICF-2001D is in the pipeline. So, we are stuck at least for the immediate future with the ICF-2001D as THE portable of choice for serious SWL or DX use. Despite its reputation as the best in its class the ICF-2001D has many shortcomings. This article hopes to address some of those shortcomings, suggest improvements, and attempt to attain the "ultimate portable".



IMPROVEMENT AREAS

In order to provide the most useful information in an easily useable form it was decided to break the modifications/improvements to the ICF-2001D down into sections. These fall into the natural categories of Audio stage, Antenna/RF stages, IF/Mixer/Selectivity stages, power supply, and miscellaneous hints. However, a **WARNING** before proceeding. SONY used a mix of discrete components, SMT and LSI components on double sided printed circuit boards in the construction of this receiver. IF YOU DON'T KNOW WHAT YOU ARE DOING DON'T EVEN TRY. Having said that, many of the following tips/hints require little tecnical knowledge. But don't attempt any modification if you are not sure of your abilities, and bear in mind that many of the modifications will void your warranty. For a large number of the modifications detailed below access to the full SONY service manual is essential, SONY part # 9-951-647-12 including update # 51-647-91.

POWER SUPPLY

The logical place to start with any portable is the power supply section and SONY's battery arrangements for the ICF-2001D have certainly attracted criticism.
a). The memory batteries are a major bone of contention because of the tendency of the receiver to arbitarily wipe the memories, clock and timer at moments of most inconvenience. The problem arises from the standards against which batteries are constructed. The IEC specification for R6 batteries does not specify physical size in absolute terms but in terms of maximum and minimum limits as to length, diameter, etc. As a consequence some AA cells (IEC R6) are slightly larger than others. The batteries specified by SONY Eveready # 1015 are, for example, slightly larger in diameter than Mallory cells. Therefore some batteries sit more snugly in the battery compartment than other brands. The problem of memory loss is caused by movement of the batteries within the compartment causing noise on the memory supply rail, rather than actual loss of power to the memory components. Now, there are various solutions to the problem as follows;

i) Simplest cure is to wrap tape around the memory batteries to increase their diameter and ensure a tight fit in the battery compartment. Although not a total cure, this technique considerably reduces the number of times that "memory wipe" occurs.

ii) An alternative is to hardwire a LITHIUM memory back-up cell into the memory battery compartment. Bear in mind that normal AA cells (IEC R6) are 1.5 volts each. Lithium cells are nominally around 3 volts per cell so only one battery is required. A suitable lithium cell is the Radiospares AA sized lithium cell which is fitted with solder tags (part # 592-313). Note that Lithium cells, unlike Nickel-Cadmium cells, are not normally rechargeable. Be careful to observe correct polarity when installing the battery. Lithium cells have a very long shelf life and in conditions of low current drain (as in this application) effective life is also very long.

iii) A third possibility is to back up the normal AA memory cells with a high value, low voltage electrolytic capacitor. Finn Ritz Jorgensen in a contribution to DSWCI (Ref 1) indicated he had used a 2200uF 10VDC electrolytic capacitor to provide backup (and some smoothing of the noise on the supply rail) for the AA memory cells. The capacitor must have both leads on the same end (ie: not an axial leaded capacitor). The leads can be extended with thin insulated wire and the electrolytic stuck inside the receiver close to the loudspeaker with "Superglue" or similar. The positive wire is connected to the positive tag on the right hand end of the memory battery compartment. The negative lead goes to the nearest convenient 0V ground land. I have also used a 10,000uF 6VDC electrolytic succesfully and my own ICF-2001D is currently fitted with a one Farad 5.5VDC memory back-up capacitor (Radiospares part # 115-039). This solution has the added advantage that the charge held by the capacitor is sufficient to allow changing of the memory batteries with no loss of the memory contents. With the one Farad electrolytic, the ICF-2001D will run for over ten minutes with the batteries removed before the

charge is lost. Similar large value electrolytics are available from Maplin Electronics (see Sources). A one farad 5.5VDC electrolytic (42x32.5x15mm) part # FA25C is available at £5:96. A pcb mounted one Farad electrolytic (8x21.5mm dia) is available as part # JR018 at £3:95.

b) The main 4.5V power supply seems to be less of a problem than the memory back up supply, but some comments are necessary.

i) It should be noted that in a receiver costing close to $400 SONY chose to save 10¢ on a protection diode for the external DC input socket. External power supply reversal will cause the ICF-2001D to suffer severe internal pains of a terminal nature! This is not a problem in most areas as SONY's own power supply is available with the receiver. In the Australian market, because of local energy supply authority regulations, the ICF-2001D is sold without an external power supply. For the benefit of Australian (and New Zealand) SWLs and DXers, there are four versions of two different power supplies available. The appropriate one to order is "Adaptor, AX:AC140W, part # 1-463-633-00".

ii) If you use a power supply other than SONY's you must ensure that the DC input plug to the receiver is negative tip. The easiest way to protect the ICF-2001D is to fit a protection diode across the DC input socket within the receiver. A one amp rated diode, or higher, soldered across the appropriate points on the jack board (see relevant pages in the SONY manual) will provide "crowbar" protection against power supply reversal. Effectively the diode does nothing when a power supply of the correct polarity is connected. However the diode presents a dead short circuit to a reversed power supply. This might not do the power supply any good at all but it will protect the ICF-2001D!

iii) SONY's own power supply for the ICF-2001D is not regulated and in fact the receiver will happily run on 5.5 volts or higher without damage despite the nominal 4.5 volt requirement. I have run my own ICF-2001D with no problems from a solar panel which provides a nominal regulated 6 volt (in fact nearer 5.8 volts). The solar panel used is a flexible unit that looks rather like a four ring binder. When unfolded it measures 13 1/2 x 9 5/8" and is less than 3/8" thick. The unit comes with a small regulator and provides a regulated 6, 9 or 12V at up to 400mA in full sunlight. Even with half the unit covered it still powers the ICF-2001D quite happily. The unit is extremely useful for DXing on the beach or at a poolside barbecue for those who live in sunny climes and wish to save on battery costs. The unit is a "Sun Pal 105" and further information can be obtained from Sovonics (see Sources).

iv) The consensus of those I've talked to is that, in normal use, Alkaline D cells (IEC R20) are far more cost effective than ordinary zinc-carbon D cells. On a trip round SE Asia in Dec/Jan 88/89 I used my ICF-2001D heavily on a daily basis through 7 countries over 17 days. The alkaline D cells were fitted new at the beginning of the trip and still lasted for weeks afterwards despite very heavy use. As an alternative you might like to consider Nickel-Cadmium ("Ni-Cad") cells. John Albert (WA9FVP) in Monitoring Times (Ref 2) describes the use of re-chargeable Nicads. The problem with Nicads is that they only produce 1.2V rather than the 1.5V of Zinc-Carbon cells. Three Nicads add up to only 3.6V rather than the 4.5V of Zinc-Carbon cells. The ICF-2001D starts to hiccup and distort at 3.3V approximately which means that the Nicads are working on the limit of their voltage rating. John used two ordinary C cell size Nicads and two Radio Shack "Sub C" size cells. These four cells fit snugly into the main battery compartment (with foam padding) as they are the same overall length as three D cells. John also describes in his article the addition of a charger socket to the ICF-2001D to permit charging the Nicads with a 9V adaptor. Charging can take place overnight or whilst the radio is running of the normal external 4.5V power supply. The parts count for the charger modification is minimal but it does require some cabinet surgery to mount the input socket. I can vouch for the effectiveness of this particular modification. After reading John's article I fitted Nicads and charger input to my own ICF-2001D and have not had to purchase batteries since! John has indicated he can answer enquiries but please enclose return postage and a response may not be immediate due to pressures from other projects. For European owners of the ICF-2001D Maplin Electronics (see Sources) also

stock "sub C" style Nicads. These cells are tagged (although the tags can be removed) and are intended for model radio-control purposes. They are 42mm long (C cells are 50mm, D cells are 61mm). So, three D cells are 183mm in length at 4.5V nominal, whereas two x C cells plus two x sub C cells are 184mm long at 4.8V nominal. Part number of these "SC" cells (which is what Maplin call them) is JF98G and cost is £2:45 each.

AUDIO PERFORMANCE

In what amounts to a fairly sophisticated (and expensive) portable, SONY didn't get things right as far as the audio performance. Complaints have surfaced about the ICF-2001D's "muffled audio", audio distortion and low level tape output among others. Certainly SONY hasn't been able to produce a portable in this price range with the kind of audio associated with Grundig products, despite SONY's proven track record in Hi-Fi consumer electronics.

i) The low level output for taping seems to be a common complaint with most SONY AM/FM/SW portables and seems to be a deliberate design ploy. It would appear that the output level and impedance is designed to interface with the microphone input of SONY's portable cassette recorders. Certainly the ICF-2001D's tape output provides a near perfect match to the microphone input on SONY's semi-professional TCM-500EV cassette recorder. Dale Wagner also notes that the tape output works well with the microphone input of a micro-cassette recorder which is possibly the ideal solution for those who have to travel light. If your cassette recorder has only line input facilities reducing the value of R200 (see SONY manual) may help. As supplied, the ICF-2001D tape output produces around 3.5mV into a high impedance (One Megohm) load for a -35dBm, AM signal modulated at 60% with a 1kHz tone. Short circuiting R200 brings this level up to around 30mV. You'll have to experiment with resistor values to find a good input level match to the particular tape recorder you are using. R200 is a very small surface mount resistor on the extreme left hand side of the main board and is accessible without major dismantling of the receiver. Steve Whitt (Ref. 9) suggests reducing R200 to 10 Kilohms from the original 18 Kilohms, and increasing R201 to 2.7 Kilohoms from the original 1 Kilohm. R201 is located immediately below R200 on the main PCB and is also a surface mount resistor. Increasing R201 will provide a better impedance match to a cassette recorder line input.

ii) SONY's proprietary synchronous detection IC, the CX-587, is capable of producing AM stereo as well as synchronous detection. John Albert (WA9FVP) in his "Monitoring Times" article (Ref. 2) also describes a modification to provide an AM stereo low level output. Once again this requires "surgery" to add an output socket but may be of interest to ICF-2001D owners in North America and Australia who have local AM stereo stations. The modification works with the Motorola system as used in Australia but I can't comment on the Kahn system which isn't available in my part of the world. Note that the output is very low level and you will need to feed it into a stereo amplifier. John Albert also suggests that the ICF-2001D's internal speaker can be used for one channel while the other sync/stereo channel could be fed to a small mono amplifier and speaker combination. Incidentally, has anyone any information on the synchronous-detection CX-587 IC (eg: a data sheet) with information on signals available (if any) on the unused pins?

iii) Unlike the much cheaper Sangean ATS-803A the ICF2001D does not provide stereo headphone output on FM which is an unfortunate ommission in a receiver of this price. Whether the retrofitting of a FM stereo output is really worthwhile is up to the individual. I have done some experimentation using a National Semiconductors LM 1800 PLL FM Stereo Demodulator (Ref. 3) which requires only a few additional parts (see Diagram One). I'm not sure it is worth the time and effort to develop the idea any further but some SWLs or DXers might be interested in experimentation. Sprague have also recently released a single-chip FM Stereo Decoder (Ref.10) which, once again, requires very little in the way of additional components to produce a functional headphone-level stereo output.

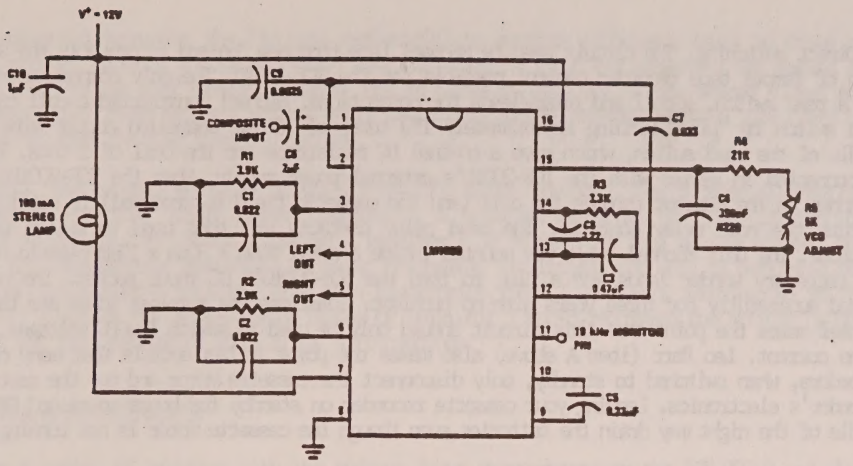


DIAGRAM ONE

iv) SONY provided very comprehensive timer facilities to allow taping of your favourite DX programme, but the ICF-2001D has no facility for remotely switching a tape recorder. This is not a problem for me as my own TCM-500EV cassette recorder has VOX operation capabilities. In addition I don't like leaving a cassette recorder in the record position for long periods of time. If the recorder's pinch wheel is left pressed against the tape capstan it can cause eventual damage to the pinch wheel. So, remote switching is not an area that I have investigated. Others have though, as follows;

A) Current sensing. The circuit in Diagram Two was used by Leo Barr (Ref. 4) for remote switching a cassette recorder with a Sangean ATS-803A. The circuit is designed to sense the voltage drop of a 7.5V (nominal) external power supply when current is drawn. When the ATS-803A switches on the current drawn causes a voltage drop across D1 and D2 switching on TR1, the BC108 transistor then switches the relay (a 5 volt relay in this circuit). This circuit can be modified for use with a SONY external power supply and an appropriately lower voltage Zener diode and relay. Incidentaly, the US equivalent of the BC108 is the 2N3904 or 2N2222. Though as Nick Hall-Patch points outs any small signal NPN transistor will work in this circuit.

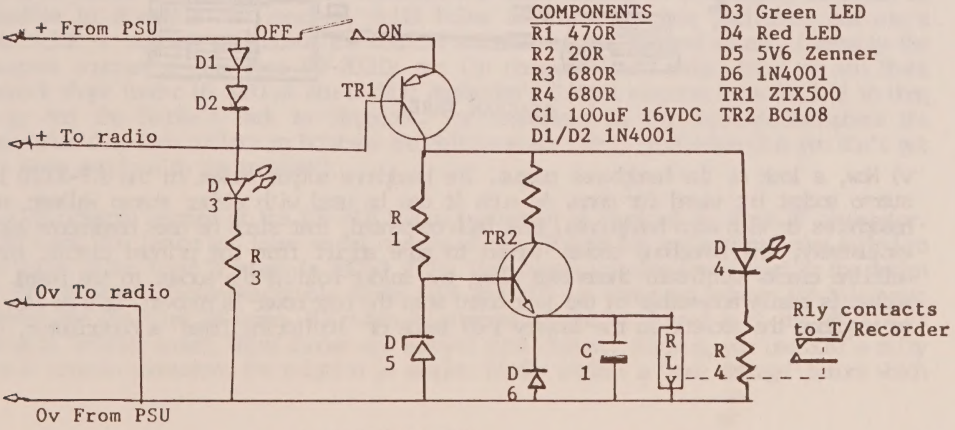


DIAGRAM TWO

B) Direct switching. The circuit used by Michael Laba from New Zealand is probably the simplest form of remote tape recorder control possible for the ICF-2001D. The only components required are a reed switch, a coil and plugs/leads for connections. Michael constructed a coil round the reed switch by "pile" winding approximately 150 turns of 35 swg enamelled copper wire on the middle of the reed switch, which gave a nominal DC resistance for the coil of 3 Ohms. The coil is connected in series with the ICF-2001D's external power supply. When the ICF-2001D's timer switches on the current through the coil (and the magnetic field so produced) is sufficient to operate the reed relay contacts. The reed relay contacts are then used to switch the tape recorder. The unit Michael built was mounted inside a small 40mm x 30mm x 15mm plastic box with the necessary wander leads and a plug to feed the ICF-2001D's DC input socket. The unit has worked succesfully for three years with no problems. Sometimes the simplest ideas are the best! Michael makes the point that this circuit should only be used to switch low DC voltages and NOT mains current. Leo Barr (item A above) also makes the point in his article that many cassette recorders, when switched to standby, only disconnect the cassette motor and not the rest of the recorder's electronics. Leaving your cassette recorder on standby for hours to record DX in the middle of the night may drain the batteries even though the cassette motor is not running.

C) The easiest approach of all. For those who dislike soldering irons, the simplest way is to buy it pre-fabricated. Saul Berger of Soltronic, formerly the Solar Light Co., manufactures a cassette controller called the CC 2020. The cost is around $37:50 and Soltronics address is listed in the Sources list at the end of this article. The principle, which seems to be current sensing, is similar to above ideas in terms of the connections required. The information in Diagram 3 should be self explanatory. Saul advises that CC 2020 can also be used with Sangean and Panasonic radios.

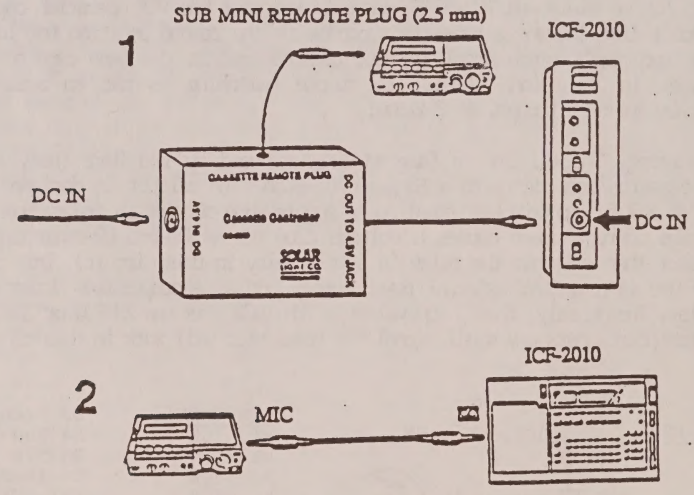


DIAGRAM THREE

v) Now, a look at the headphones output. The headphone output socket on the ICF-2001D is a stereo socket but wired for mono. As such it can be used with either stereo Walkman style headphones or with mono headphones. Bill Babb commented, that since he uses headphones almost exclusively, the headphone socket tended to come adrift from the printed circuit board. Hairline cracks manifested themselves along the solder holding the socket to the board. The socket is easily accessible on the jack board when the rear cover is removed. It's an easy job to resolder the socket. In the January 1989 issue of "Monitoring Times" a contributor, Doug

Darius, suggested bypassing the limiting resistor(s) to provide sufficient level to drive an external speaker such as the Grove SP100 "Sound Enhancer". These two resistors are marked as R301 and R302 on the SONY circuit diagram. One is wired in each leg of the stereo socket and are 47 Ohms each. These two are surface mount components easily accesible on the jack board of the ICF-2001D when the rear cover is removed.

vi) Finally, the overall question of the ICF-2001D's audio "quality". One further alternative is to bypass the SONY audio stages completely. A solution would be the Kiwa Electronics Multiband AM Pickup (MAP) which picks up a receiver's IF signal (as long as its 455kHz) and provides full synchronous detection and audio processing facilities. The unit is available for around $340 (plus post & packing) from Kiwa Electronics, 9815 61st South, Seattle, WA 98118, Phone (207) 722-KIWA. For an excellent review of this unit I would recommend the article by Guy Atkins in the 1989 edition of Fine Tuning's Proceedings.

ANTENNA & RF STAGES

There are a number of problems with the antenna input arrangements on the ICF-2001D and also with the RF stages.

i) Firstly a word of warning for those contemplating buying an ICF-2001D from an overseas duty-free source. There are effectively five different versions of the 2010/2001D. The standard familiar version appears as either the ICF-2001D or the ICF-2010, has full uninterrupted coverage from 150-29,999.9kHz, full FM coverage from 76-108MHz, provides airband coverage and is fitted with USB/LSB selection. Some models, with the same model numbers, are supplied with permutations of the following. No airband coverage, no USB/LSB switching, restricted 87.5-108MHz FM coverage, a gap in coverage at 285-530kHz, or coverage ending at 26,100kHz on AM. If you buy overseas be cautious and ask questions. That is no consolation for those stuck with a restricted coverage receiver because of local regulations as in Germany, France or the Middle East. Fortunately it is relatively easy to restore some of the missing coverage. There are four links on the keyboard printed circuit, associated with diodes D511 and D512, which inhibit the signal lines from the encoder IC. These links inhibit four seperate functions. 1) Coverage from 285-530kHz, 2) Coverage of the Airband, 3) Coverage from 76-87.5MHz, and Coverage from 26,100-29,999.9kHz. All that is required to restore full FM coverage or full AM coverage is to remove the appropriate solder links. The links are not easily accessible and careful dismantling of the receiver is required. If you have a restricted coverage version of the ICF-2001D it's probably well worth the effort though. Restoration of the AIR band is probably not economical as the selection switch is missing from these versions along with a couple of dozen components. From the SONY manual it would seem that in some versions of the receiver everything is installed for USB/LSB switching except the push buttons on the front panel - the keyboard matrix is the same for all versions. For those willing to try surgery it should be possible to dismantle the receiver, drill holes in the appropriate positions, and use a matchstick or similar to operate the USB/LSB switches on the keyboard matrix. Currently the cheapest sources of duty-free ICF-2001Ds are (in cheapest first order) Dubai or Abu Dhabi airport shops (under US $280 at Abu Dhabi); Amsterdam's Schipol airport; Tsim Sha Tsui in Hong Kong; and the People's Park in Singapore. For travellers in the Southern Hemisphere the Australian duty-free outlets in Brisbane and Melbourne are fairly good value (but you don't get the power supply with the receiver).

ii) The original version of the ICF-2001 had no protection in front of the first RF transistor. SONY learnt the lesson and later serial numbers of the ICF-2001 had protection diodes fitted to the input of the first RF stage (a 2SK107 JFET). That lesson was also transferred to the design of the ICF-2001D. Protective double diodes D304 and D305 are connected between the telescopic antenna and the first RF stage. BUT, when an external antenna is plugged in to the ICF-2001D's external antenna socket these diodes are removed from circuit! Assuming you use SONY's nifty little antenna connectors the solution is simple. Diodes exhibit a "knee voltage" before which

they will not conduct. So, back to back diodes will not affect the weak RF signal you are trying to hear but will short circuit static pulses which could damage the 2SK152 front-end JFET. My own solution, and that of Richard Gordon, is to install protection diodes inside the little plastic antenna box that SONY supplies with each receiver. Richard only used two diodes whereas I used four in series/parallel to reduce possible cross-modulation problems. Both Richard and I used 1N914 diodes but virtually any small-signal diode would do. For North American owners of the ICF-2001D Richard quotes the Radio Shack part number for the 1N914 as #276-1122 and cost as 10 for $0.99. Both the two and four diode solution are shown in Diagram Four.

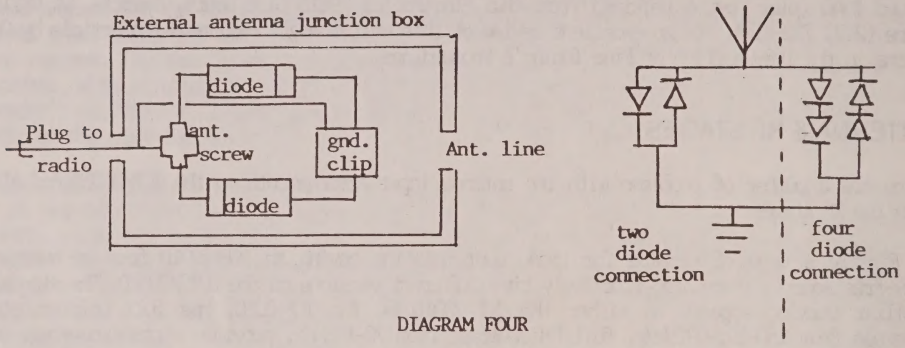


DIAGRAM FOUR

iii) OK, so you didn't have any protection and you had a beverage antenna connected during thunderstorm. What do you do if you have prematurely terminated the life of the input JFET? Luckily Q303 is easily accessible as it is located on the jack board and not the main PCB. However, be very careful when working on this board as it is very easy to break the thin wires going to the ferrite rod antenna. The 2SK152 is not too hard to come by and SONY will supply it. The problem with substitution is the low supply rail used by SONY in this receiver. The rail voltage of 3 volts severely limits any choice of replacement. Finn Ritz Jorgensen says he ended up using a dual-gate MOSFET (a 40673). By connecting gate 2 directly to the drain of the device he ended up with a three terminal MOSFET with far better input protection than the stock 2SK152. The 40673 has worked so well that Finn says he never bothered to install the 2SK152 he got from SONY later. Guy Atkins used a Motorola MPF102 JFET as a substitute. As Guy notes the MPF102 is available virtually worlwide. From Motorola's data sheets I would say that the MFP102 is working virtually on the lower limit of its drain/source voltage curve with a 3 volt rail but Guy says it works just as well as the 2SK152 and seems to be less static sensitive. Other substitutes/equivalents recommended have been the ECG312, J304 and 2N5951.

iv) Front end overload. The ICF-2001D has a less than spectacular dynamic range when compared with a receiver like the R71A, the NRD525 or the R5000 but it does cost a lot less. The ICF-2001D, like any portable, is designed to provide adequate sensitivity with its built in antennas. Also, unlike the original ICF-2001, SONY's current offering has no bandpass filtering in the front end. All RF signals from DC to daylight appear at the gate of the front end JFET on the 150-29,999.9kHz range (the Airband does have bandpass filtering). On top of all this SONY chose to place selectable attenuation in probably the worst place possible. The RF gain control is virtually useless at preventing cross-modulation since it is located after the pair of 2SK152s comprising the first mixer stage (Q1 & Q2). Any overdriven mixer is inherently non-linear and cross-modulation is inevitable if these transistors are faced with high unwanted RF levels. The DX/Local switch is more effective but it still comes after Q303 (that front end

JFET again!). If you wish to use an external antenna then either limit yourself to SONY's supplied length of antenna wire (even this is too long for RF alleys like Western Europe) or use attenuation and passive preselection between the antenna and the receiver. Note, I said passive. Many of the available makes of active antenna will give the ICF-2001D severe RF indigestion. There are at least two possible exceptions to this. I have used succesfully a Datong AD270 indoor active antenna but with a stepped attenuator between the AD270 and the ICF-2001D. Guy Atkins and myself have also used a very nifty active antenna called the AC-1 micromodule antenna from Inline Components (see Sources). This antenna works very well with the ICF-2001D as it does not have excessive gain. In addition it is indeed "micro" in size and is ideal for the travelling DXer who has to travel light. The unit comes with a "sucker" like hook to hang the antenna from your hotel bedroom and a ferrite rod coupler is available for BCB/MW listening. Wes Olsen of Inline Components is very helpful and he suggests that anyone interested in the AC-1 contact him for details. Costs are $31:00 for the AC-1, $58:00 for the AD-2 AC/DC portable version, and $15:00 for the ferrite antenna coupler. Prices are exclusive of shipping charges. However, the caveat still applies. With the ICF-2001D, be very wary of connecting large or active antennas capable of producing high RF levels into the front end of the receiver. Cross-modulation is inevitable in anything but a very quiet RF environment and there are few of those places left! The SONY active antenna, AN-1, seems to have been designed with the ICF-2001D's (and other SONY receivers) shortcomings in mind and has very low overall gain to the point of insensitivity.

v) Connection of BCB/MW antennas to the ICF-2001D is another problem. When an external antenna is plugged into the AM antenna jack on the receiver all of the LW/MW circuitry is disconnected. This includes the ferrite rod antenna, the 2SK152 RF amplifier (Q302), and the 2SC2785 AGC stage (Q301), and in any case the ICF-2001D circuitry is deliberately desensitised below 2MHz as part of SONY's design philophosy. This, in fact, works well when a tuned loop antenna is used but creates problems when a random wire is used. I have only done a little experimentation in this area so any input and ideas would be welcome. Enrico Oliva has used a "magic disc" frame antenna. This is produced by Deutschelandfunk (see Sources) and is the size of an LP record. It is supplied fixed-tuned to DLF's channel. Enrico substituted a variable 365pf capacitor to make the unit tuneable. With the ICF-2001D mounted inside a wooden support frame, and the "magic disc" on top, a marked improvement in BCB/MW reception is noted. From Enrico's notes and sketch, coupling between the ICF-2001D and the "magic disc" is inductive. Enrico says that the "Magic disc" is sent free of charge by DLF to European listeners who experience difficulty in receiving DLF's transmissions. The device is costly to produce and obtaining one might be difficult if you live outside Europe. Fritz Mellberg also notes that Radio West in California (see Sources) produce a simple tuneable ferrite rod antenna which will inductively couple with the ICF-2001D and improve BCB/MW reception. Enrico Oliva also detailed his cure for overload and spurious signals from his 30 metre longwire antenna. Inside SONY's antenna terminal box he mounted a 0.01 uF capacitor in series with the antenna and a 41 Ohm resistor from the braid of the incoming co-axial cable to the tip connection of the lead to the ICF-2001D's antenna input socket. Finding the right combination of capacitor/resistor will require some juggling to match your own antenna set up.

vi) Steve Whitt (Ref. 9) suggests a novel method of restoring the lack of sensitivity below 2MHz. If the 3.5mm antenna plug is not fully pushed into the antenna socket on the ICF-2001D, but only just inserted, the input filter which causes the desensitisation is bypassed. However, once again beware of front end overload.

vii) Beverage antennas. If you want to try a beverage with the ICF-2001D (assuming you have fitted protection diodes in the antenna connector!) Steve Whitt describes an interesting matching unit. The unit uses a 365pf or 500pf variable capacitor and switched inductors rangining in values from 6.8 to 470 uH. These are stock values so coil winding is not required.

viii) Finn Ritz Jorgensen uses a magnetic loop with coverage from 9 to 30MHz (down to 5.5MHz

with added capacitance) which cures the front end selectivity problems on Finn's ICF-2001D. The loop consists of a 70cm diameter loop of 50 Ohm co-axial cable. The cable used is high quality with a solid (not braid) outer screen. A 7-150pf variable capacitor is mounted on a "Tee" piece of perspex at the top of the loop for tuning. The co-axial cable is 16mm flexible co-ax with the outer insulation stripped off. A 37cm loop of insulated hook-up wire is soldered between the outer and inner cores of the co-ax at the base of the loop and the pickup feed to the ICF-2001D is taken from this point. Further information on loop antennas for portable receivers is available in Ref. 12.

ix) As noted in iv) the easiest method to get around cross-mod problems with the ICF-2001D's front end is to use passive preselection. Steve Whitt describes a passive preselector in his series of articles (Ref 5. & 9). John Tow has suggested the circuit in Diagram Five.

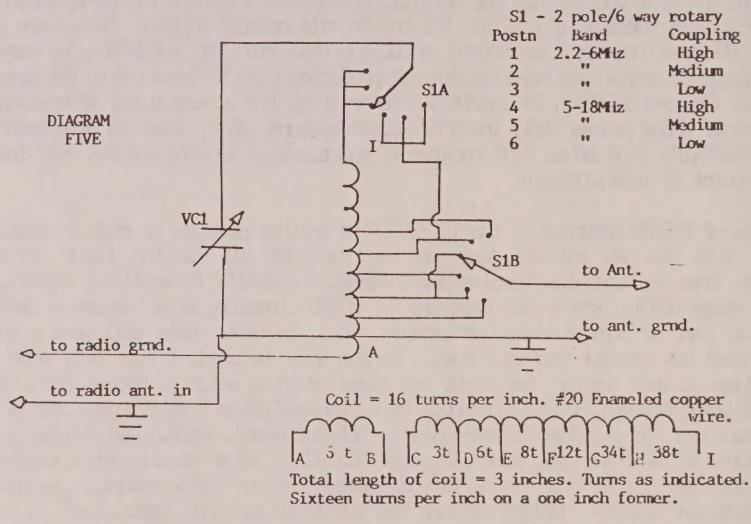


DIAGRAM
FIVE
S1 - 2 pole/6 way rotary
Postn Band Coupling
1 2.2-6MHz High
2 " Medium
3 " Low
4 5-18MHz High
5 " Medium
6 " Low
S1A
I
VC1
S1B
to Ant.
to ant. grnd.
to radio grnd.
A
to radio ant. in
Coil = 16 turns per inch. #20 Enameled copper wire.
A 5t B C 3t D 6t E 8t F 12t G 34t H 38t I
Total length of coil = 3 inches. Turns as indicated.
Sixteen turns per inch on a one inch former.

This passive preselector covers 2.2 to 18MHz in two switched ranges. The tuning capacitor allows the circuit to be peaked to resonance in conjunction with the tap on the coil. John housed his unit in a plastic case with a metal lid on which the tuning capacitor was mounted. He used a stock coil but a similar coil cab be wound on a piece of PVC tube with # 20 SWG enammelled copper wire. The variable capacitor is a standard variable (around 365 to 500 pf maximum capacitance). Don't use the minature style used in modern transistor portables - the minimum capacitance is too great. For those who prefer not to "homebrew", MFJ manufacture a ready-built passive preselector (# MFJ-956) costing US $37:95 which is available from Universal Shortwave (see Sources).

x) Finally Dale Wagner points out that if you are using an odd length of wire as a random "longwire" you only need a 3.5mm jack plug. The antenna needs to be connected to the tip of the plug only. An easy way of connecting an antenna quickly when you're out in the bush.

SELECTIVITY

Much has been written about the selectivity of the ICF-2001D. Selectivity however is a two sided coin. Selectivity can be measured in completely objective terms specifying parameters such as 3 or 6db bandwidth, 60db bandwidth, passband ripple, etc. But selectivity is also subjective. Depending on your interests (and your hearing!) what is too wide a filter for your purposes may be too narrow for someone elses. SONY compromised just as any other designer has to do when producing consumer electronics. SONY had to juggle cost, physical

size to fit on a cramped PCB, good audio response on strong local stations on BCB/MW, and reasonable selectivity on fading, weak shortwave signals. All this in a mass-market portable. Whether SONY got the balance right is very much a matter for individual judgement. Those that have been dissatisfied have tackled the task of effecting a "better" choice of bandwidths. Diagram six shows SONY's IF filtering arrangements for the ICF-2001D.

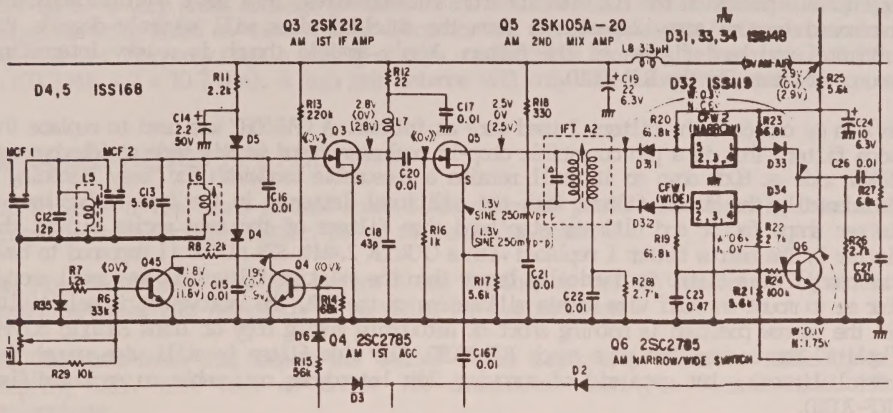


DIAGRAM SIX

The two filters marked MCF 1 and 2 are first IF roofing filters. The actual IF selectivity is provided by the filters marked CFW 1 (wide) and CFW 2 (narrow). These filters are nominally (at -6 db) 11kHz wide and 4.4kHz narrow. Changing them for either narrower filters or filters with a better shape factor is tricky for two reasons. The filters are mounted on the very densely crowded main board. Components are flow soldered to both sides of the board in the vicinity of the filters and care is required when removing and replacing the original filters. Secondly, because of the limited space, any replacement filters need to be the same physical size and to be pin compatible. The existing filters are made by Murata and are part # CFW455G (wide) and CFW455JT (narrow). A number of retailers of replacement filters can be found in Sources.

i) Steve Whitt, in an excellent and highly recommended series of articles on the 2001D (Ref. 5) replaced only one filter. Steve used a filter from Radio West (see Sources) to replace the narrow filter and then used the original narrow filter to replace the wide filter. This resulted in measured -6db bandwidths of 2.95kHz narrow and 4.2kHz wide. Steve also points out that as the filter in the wide position is used for Airband this modification results in an improvement in selectivity for this band as well.

ii) Finn Ritz Jorgensen (Ref. 1) went one stage further and replaced both filters. The AM wide ceramic filter was replaced by a CFG455G and the narrow filter by a CFG455J. Both these are Murata components and the CFG filters have a markedly better shape factor than the CFW filters. However, the CFG filters are not direct pin compatible, drop in, replacements, although they are the same physical size as the originals. You'll need a magnifying glass and a pair of tweezers to bend the filter's pins to the right angle. Finn chose those filters to give an acceptable level of fidelity in the narrow selectivity position. Murata's specifications for these filters are - CFG455G 8.0/20.0kHz bandwidth at 6/60db, CFG455J 3.0/9.0kHz bandwidth at 6/60db (although Finn quotes 9.13/13.6kHz and 5.2/7.5kHz respectively). These filters (and the full range of CFW, CFU and CFG Murata filters) are available from Bonex in the UK (see Sources). However I've been unable to locate a US source

who will supply in small quantities.

iii) John Albert in his "Monitoring Times" article (Ref. 2) describes improving the selectivity of his ICF-2001D by using an ICOM FL30 filter. It is unclear from John's description just where in the circuit he used the FL30. In addition, this is a fairly large filter and John installed it by taping it inside the receiver and extending it to the appropriate points on the PCB with six inch shielded wires. This isn't a modification I'd recommend because stray capacitance from the shielded wires will severely degrade the ultimate stop band figures of the filter. John's article though is a very interesting source of ideas for the ICF-2001D.

iv) In my own case the filters I used were as follows. A CFW455HT was used to replace the wide filter. This is a pin compatible drop-in replacement and is 6kHz wide at 6db down and 18kHz wide at 60db down so it still retains a reasonable bandwidth for "easy listening". Incidentally the Murata filters with the additional letter T in the type number have a better shape factor and ultimate stop band than filters of the same series without the letter T. The narrow filter I replaced with a CFJ455K 2.4kHz SSB filter (I happened to have one handy). This filter is physically larger than the existing filters but was small enough for me to mount on stiff wire within millimetres of the PCB. The improvement in selectivity in the narrow position is nothing short of astounding making copy of Trans Pacific BCB/MW "splits" far easier than on a stock ICF-2001D. The wide filter is still wide enough for normal listening but gets rid of annoying 5kHz hetrodynes noticeable on an unmodified ICF-2001D.

v) Lastly on 455kHz filters. If you are shopping around for replacement filters here are the relevant specifications for the two existing filters. Input and output impedance 2000 Ohms; insertion loss 6db; physical size 11mm long, 7mm wide, 6.5mm high. The bandwidths specified in Murata's literature are CFW455G ± 4.5kHz at -6db and ± 10kHz at -50db; CFW455JT ±3Khz at -6db and ± 5kHz at -50db.

vi) The IF bandwidth of the ICF-2001D on VHF/FM is fairly wide, at least 300kHz wide at 6db down. This is fine for stereo but if you have no intention of experimenting with stereo decoders then an improvement is possible. A narrower bandwidth will give better adjacent channel rejection for FM DXing. The appropriate 10.7MHz IF filters are marked as CF1 and CF2 on the ICF-2001D's circuit diagram. These are identical units. Replacement provides a minor problem because of the method by which ceramic filters are manufactured. The manufacturing process produces a wide spread of centre frequencies even though the centre frequency is supposedly 10.7 MHz. Murata's ceramic filters, for example, are produced in batches which are then colour coded according to approximate centre frequency. Black, blue, red, orange and white spots on the filter refer to nominal centre frequencies of 10.64, 10.67, 10.70, 10.73 and 10.76 MHz respectively. It is essential that the two replacement filters are a matched pair. Although zero offset from 10.7 MHz is ideal, in practice the precise offset from the 10.7 MHz nominal centre frequency is not that critical as long as both filters have identical offsets. The FM IF filters in the ICF-2001D are the industry-wide standard minature units with 3 pins in line. The existing filters are Murata SFE 10.7 MA. Murata quotes a 280 kHz bandwidth at -3db and 650 kHz at -20db with an insertion loss of 6db. An ideal FM filter would be 150 kHz wide with steep sides to accomodate normal FM broadcast deviation of ±75 kHz. Steve Whitt (Ref. 9) suggests replacement of the existing filters with Murata SFE 10.7 MJ filters. These have a quoted -3db bandwidth of 150 kHz and a -20db bandwidth of 400 kHz which is a big improvement. However, these filters have a 10db insertion loss. Replacing both filters will give a hefty additional 8db loss through the ICF-2001D's IF on top of the fact that the receiver is not particulary sensitive anyway. In my own case I used Murata SFE 10.7 MS3L filters which have a slightly wider -3db bandwidth of 180 kHz but an insertion loss of only 3.5db. These filters are so cheap (60 pence each in the UK) that experimentation isn't going to break the bank. Basically, any replacement filter needs to have an insertion loss of 6db or

less, a bandwidth of around 180 kHz and an input/output impedance close to 330 Ohms. The two filters are located on the ICF2001D's main PCB and are easier to replace than the AM filters. Bonex in the UK (see Sources) stock a full range of of Murata ceramic filters. It should be noted, however, that the ICF2001D is never going to make a hot-shot FM DX machine. Its sensitivity is fairly poor though this can be helped with the use of a loft/attic or outdoor antenna and a preamplifier. BUT, as well as being deaf the ICF-2001D is very prone to image problems on the 88-108MHz band. This manifests itself by stations being heard on their nominal frequency and also at twice the IF frequency below the correct frequency. Eg: a strong station on 100.3 MHz can also be heard at 78.9 MHz (100.3 MHz - 2 x 10.7 MHz). A high gain antenna will only make this problem worse.

MISCELLANEOUS TIPS AND HINTS

In addition to the areas covered above a miscellany of points were raised by those who responded to my original letter. So, in no particular order;

i) Nigel Reid notes that the airport X ray machines in the USA consisently wiped the memories/clock, etc. Apparently by resetting the microprocessor.

ii) Bill Babb notes that despite the "coarse" 100 Hz tuning steps he had no difficulty in copying RTTY. Bill uses an E.T.I. 730 demodulator driving a Siemens Model 100 teleprinter.

iii) Punch-up errors. Bill Flynn comments that erroneous entries can be cleared immediately by hitting the "AM" key which returns the previous frequency entered (or FM or AIR as appropriate).

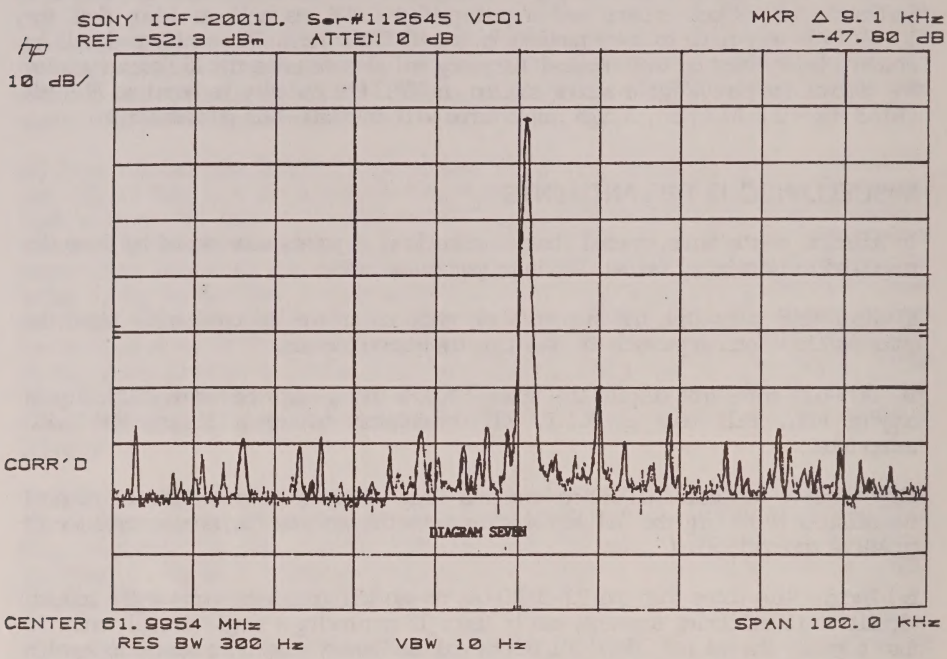
iv) Enrico Oliva notes that the ICF-2001D has no squelch control as such but the squelch circuit, utilised during scanning, can be used. If monitoring a single channel, enter it into a memory channel and "skip" all others and use "memory scan". The automatic squelch level works well, particularly on Air band.

FURTHER POSSIBILITIES

It is doubtful that we have approached the concept of the ultimate portable. Even when a receiver with the performance of an NRD-525 becomes available in a package the size of a cigarette pack there will still be widely varying views as to what constitutes the "ultimate". Hopefully some of the above modifications will help you to improve your ICF-2001D and bring it nearer to your idea of a perfect portable. But what of further experimentation? Lets take a look at some possibilities.

i) The ICF-2001D suffers from pronounced phase noise and reciprocal mixing (Ref. 6). Steve Whitt (Ref. 5) investigated this area in his series of articles. In particular he looked at the poor performance of the receiver's oscillators. Steve's receiver appears, from photographs taken from a spectrum analyser display and shown in his series of articles, to have had worse problems than my own ICF-2001D. Nonetheless, spurious products from the first oscillator (VCO1) in my receiver are clearly visible with the worst at only 48db down in Diagram Seven. Any unsuppressed spurious outputs from either VCO1 or VCO2 will produce unwanted mixing products. All of which are bad news. Steve details modifications to "clean up" the output of the local oscillators. The modification is "fiddly" rather than difficult to a accomplish. It involves the removal of the shield plate over the oscillator circuits on the main PCB and the addition of three sub-minature ceramic capacitors. I can vouch for the effectiveness of this modification as it reduced all spurious outputs from VCO1 to below the noise floor on my own ICF-2001D. On word of

warning on this mod though. On one ICF-2001D (Ser # 44512) a side effect of the modification was to produce severe instability when the receiver was tuned closed to the final IF frequency of 455 kHz. If these symptoms appear try juggling with the exact positioning of the capacitors and make sure that all of the tags on the shield plate have been resoldered to the appropriate ground land.



Incidentally, Steve collated all the information in Short Wave Magazine articles into a booklet called "Getting the best from your SONY ICF-2001D" which is available directly from Steve at 21 Cauldwell Avenue, Ipswich, IP4 4EB, United Kingdom. Cost is £4:00 in the UK, £5:00 or 13 IRCs airmail to Europe and surface mail for the rest of the world; and £6:00 or 13 IRCs airmail worldwide. The booklet contains information and further research which was not included in the original series of articles.

ii) Steve also suggests modifications to the "S" meter circuit in the ICF-2001D to give a more rational relationship between received signal level and number of LEDs lit. The modification requires the reduction of R 60 (see SONY manual) till the level of sensitivity required is reached. This is not a modification I have tried but this is a possible area for further experimentation.

iii) The synchronous detector in the ICF-2001D was the best thing since sliced bread when the receiver first appeared, because it was the only synchronous detector available in a consumer portable at the time. However, the years have shown some of the circuit's shortcomings. The ICF-2001D has difficulty in "sync" mode, dealing with SWBC stations using dynamic carrier control. Phase modulated radio data systems as used by some European stations (Ref. 7) such as DLF, BBC and RIF also cause the sync circuit to have heartburn, as do interfering signals less than 50 Hz away from the wanted carrier. Improvements to the performance of the synchronous detector would seem to be a fruitful area for further research and those interested may like to refer to an article by Trevor Brooks (Ref. 8) which describes an advanced synchronous detector. The circuit described provides DSB, LSB, USB, ISB/Stereo spread, and Quadrature outputs.

iv) The ICF-2001D's AGC circuit tends to "pump" on SSB signals because of the time constants chosen by SONY. John Albert (Ref. 2) also investigated modifying the AGC with the addition of a two transistor circuit to give a fast attack, slow decay AGC time constant for SSB reception.

v) An obvious area for further improvement is the audio quality from the ICF-2001D. Suggestions have included picking up the detected audio before the output IC, feeding it through a pre-amp/graphic equaliser combination and thence to a seperate amplifier. Unfortunately the ICF-2001D then ceases to be a portable! Any suggestions for a suitable replacement for the LA 4146 audio amplifier IC used in the receiver?

vi) The ICF-2001D has no integral noise limiter. An interesting IC has recently been released by Sprague (Ref. 11). This is a complete noise blanker on a chip. The IC is available in 16 or 18 pin, DIL or SMT packages and the external parts count required is minimal. The chip acts a true noise blanker in the IF/RF audio chain rather than just as a noise clipper. The 16 pin version is single channel, whereas the 18 pin version is dual channel for AM stereo receivers. Apparently the IC is only currently available in development quantities but it might be a fruitful area for research when more widely available.

CREDITS AND THANKS

Finally, my grateful thanks to those who answered my open letter. Without their input this article would have had a lot less information. In no particular order they were Steve Whitt (UK), Guy Atkins (USA), Finn Ritz Jorgensen (Denmark), Richard Gordon (USA), Bill Babb (Australia), Bill Flynn (USA), Dale Wagner (USA), Michael Laba (New Zealand), Saul Berger (USA), Nigel Reid (UK), Enrico Oliva (Italy) and John Tow (USA). This project took me far longer than anticipated. Nonetheless I've enjoyed reading everyone's contributions and trying to get them all together into this article. Any feedback would be very much appreciated.

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peripheral equipment

IMPROVING KEYPAD CONTROL FOR MODERN RECEIVERS

An Approach for the NRD525

Guy Atkins

Photos by Tom Zistatsis

The ergonomics or "human interfacing" of communication receivers is largely unexplored territory. Manufacturers of specialized, low production volume equipment such as Japan Radio Corporation's NRD525 receiver place low priority on making their equipment comfortable to use hour after hour.

The makers of mass-marketed products like automobiles have the budget to employ specialists in this field, and these professionals must apply their skills to every aspect of the product for acompetitive edge.

Any DXer who has used the NRD525 (or another receiver with a front panel keypad) for hours on end has found the vertical positioning of the keys to be a real pain. John Bryant in *Proceedings 1989* wrote that "It's simply unnatural for the human hand to punch something into a vertical surface. If this were not so, all typewriters and computer keyboards would have vertical rather than horizontal keyboards. Put the keypad on as a remote hooked by cable to the front face, or step into the mid-1980's and remote it with infra-red. Pulling the keypad off the front face would give the designers enough room to do some other things which badly need attention just as well."

John is an architect with industrial design experience. He understands ergonomics, and further criticizes the NRD525 keypad: "If JRC designers must put the bloody keypad on the front face, at least they should have had enough regard for their customers to provide either soft keys or rounded off hard ones. Instead JRC carefully selected hard, sharp-edged keys with front faces sloping about 15 degrees from vertical. If your hand happens to hit the key at the correct angle, it's fine. However, most of the time my fingers hit wrong and it's about like punching slightly dull knives. Is this a serious design flaw? Putting the keypad on the front face at all certainly is. The shape and hardness of the keys is merely a pain in an already sore posterior."

The keypad on the front face of the receiver is a problem that applies to other modern, digital receivers in general. Owners of the R71A and NRD515 receivers have ready solutions in the remote keypads that Icom and JRC make available, but what can be done to improve keypad operation on other radios?

DESCRIPTION

The remote keypad described in this article is designed for the JRC NRD525. However, a similar approach should work with other pushbutton controlled radios.

The concept is simple--the keypad is nothing more than a converted desktop calculator. The pushbuttons on the NRD525's front panel are connected in parallel to the pushbuttons on the gutted calculator. The press of a key on the remote keypad sends a electronic pulse to a corresponding key inside the receiver. A length of shielded computer cable connects the keypad to a plug on the back of the NRD525, while a computer ribbon cable routes the pulses from the back panel, underneath the Motherboard, and up to the appropriate circuit trace on the receiver's Display Board (behind the front panel).

This keypad permits the easy, swift entry of frequencies, memory channels, mode, bandwidth, and AGC

settings. It also gives control over the tuning rate and resolution ("RUN" button) and up/down frequency and channel slewing. The numeric keys are rearranged from the non-standard layout on the radio's front panel into the usual "10-key" configuration. The buttons on the remote keypad are twice the size of those on the NRD525, and have a softer touch. With a little practice it's possible to keep your eyes on the receiver while rapidly changing frequencies, memories, etc. by touch alone from the keypad. This ability REALLY speeds up bandscanning during a "hot" DX opening or changing grayline reception conditions.

The basic method of converting a calculator to a remote keypad for the NRD525 can apply to similar calculators. The calculator I used is a Sharp "Elsi-Mate" EL-334. It is solar-powered, measures 3-7/8" x 6" x 1/2", and comes with a useful "kickstand" on the back to tilt the unit toward the operator. Many drug and department store chains stock this model (about $14.00), or a virtually identical one marketed by Casio. The EL-334 has 24 keys, which can be used to control receiver functions most useful to you.

If the calculator you choose has more keys, and you want to control more receiver functions, you may need different shielded cable, ribbon cable, and connectors to handle more signal lines. Whatever brand and model you choose, I suggest you find one that has large, well-spaced keys. Also, if the overall size of the calculator is smaller than the EL-334, you may find it very difficult to install the necessary wiring.

I strongly recommend you have the NRD525 Service Manual available when constructing this project. You should possess excellent soldering skills. The circuit traces you will be making are delicate, and the circuitry you will be working on inside the NRD525 can be damaged by excess heat, static electricity, or sloppy soldering. Of course, your receiver's warranty will be invalidated by this surgery. Though not for the faint of heart, this project will substantially improve your radio's flexibility and speed of operation.

MATERIALS NEEDED (* = optional):

Sharp Elsi-Mate EL-334 (or similar) desktop calculator

1 sq. ft. clear self-adhesive vinyl ("contact" paper)

1 roll 1/16" wide adhesive copper tape (Active #76083, $2.47)

30 ga. wire-wrap wire ("Kynar") (Active #86349, $4.95)

5 ft. of 15 conductor, 24 ga. round shielded computer cable (Active #84023, $0.65/ft)

*1 qty. 15-pin, sub-D male connector w/solder pot contacts (Active #85079, $1.79)

*1 qty. hood (boot) for 15-pin, sub-D connector (Active #81211, $4.22)

*1 qty. panel-mount 15-pin, sub-D female connector, terminating in 15-pin flat cable connector, IDC-type (Active #58006, $4.08)

*2 ft. 15 conductor ribbon cable (Active #58101, $0.47/ft.)

*1 qty. 16-pin, dual row IDC female socket (Active #58173, $3.30)

*1 qty. 16-pin, dual row, IDC low-profile male header (Active #58146, $1.71)

OTHER SUPPLIES/MISC. TOOLS:

Small diameter heat shrink tubing, to fit 24 ga. computer cable wires

Fine or Extra Fine grade steel wool

rub-down lettering, white & black letters & symbols as needed (Mecanorma #2196600 wht., #2196100 blk., 2mm. high letters.

Triangle or arrow symbols: Letratype #68920)

protective clear plastic spray (Illinois Bronze "Crystal Clear Glaze" or equiv. from craft supply)

jeweler's screwdriver set

elec. drill & small diameter drill bits

You can save about $17 or $18 by eliminating all the parts listed above as optional, if you don't mind the remote keypad "hardwired" into the receiver via the rear panel. I chose to make the keypad so I could unplug it from the rear of the receiver, as well as making the NRD525's front panel/Display Board easily detachable from the remote keypad wiring (in keeping with the receiver's modular, plug-in approach). This involves considerable work, but results in a professional looking job.

If you hardwire the unit to the NRD525, the round cable could be routed through one of the unused VHF or UHF antenna input holes (remove plug) on the rear panel. You may need to drill a couple holes in the interior chassis to get the wires to the back side of the Display Board.

PREPARING THE CALCULATOR CASE

Current calculators such as the EL-334 utilize a sheet of rubber "bubbles" or domes that pop up and down when a key is depressed. Inside each dome is a small conductive pad that shorts out a trace on a circuit board, sending an electric pulse to the calculator IC chip and numeric display. By applying new circuit traces to the PCB, current flow can be redirected to control the NRD525.

Modifying the existing calculator PCB is simpler and quicker than making a totally new printed circuit board for our purposes. The original board is irregularly shaped, with numerous, tiny drill holes for small screws to hold the board to the calculator case. Completely recreating this specific board shape would be very time consuming.

To begin, disassemble the case halves. The EL-334 is held together by two small screws and six internal tabs. After removing the screws, a table knife or similar straight edge can be used to pop the case apart. Be careful not to break any of the small plastic tabs.

Remove all the screws holding the calculator's printed circuit board in place. Clip off wires going to the solar cell, and discard the small battery. Cut off and discard the flexible wiring board that runs from the PC board to the LCD panel. Remove and separate the rubber dome sheet and the plastic keys. Watch out for a small "U" shaped metal rod that may fall out from behind the EQUALS key. Notice how the wire rod is used, because it will be needed at reassembly.

Set aside the numeral keys 0 to 9 and the decimal point key. Using the fine steel wool, gently buff off the printing on the other keys. With care, you should end up with smooth, blank keytops. You'll need to decide on the functions of your receiver that you wish to control remotely, keeping in mind the number of keys on your particular model of calculator.

The blank keys are labeled using the rub-down lettering, and protected from wear with a few thin coats of clear plastic protective spray. The brand of spray I used (listed above) gave excellent results, and is described as "flexible" and "non-yellowing". The keys for MODE, BANDWIDTH, DOWN, and UP need arrow or directional triangles, with the appropriate wording just above the keys on the calculator case itself.

Use your imagination when camouflaging the upper portion of the top case. Thanks to the ingenuity of *Proceedings* Senior Editor John Bryant, my remote keypad is covered with custom graphics. He had a trophy shop imprint a thin, brushed aluminum panel with a map of the world and appropriate lettering. I covered the aluminum panel with clear 1/16" thick Lexan plastic for protection.

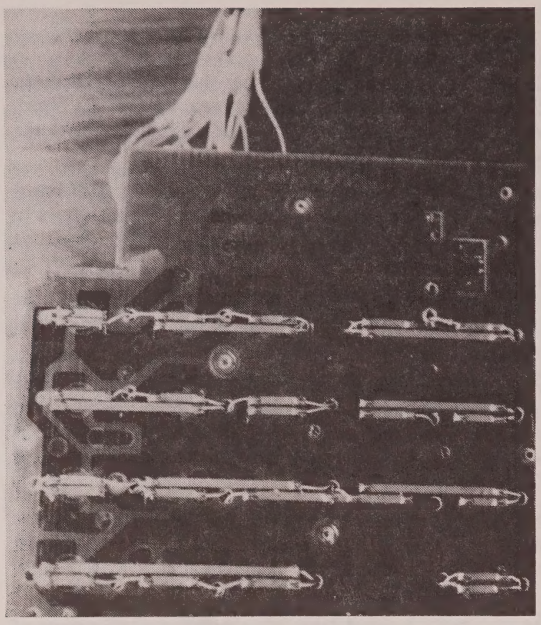
KEYPAD WIRING

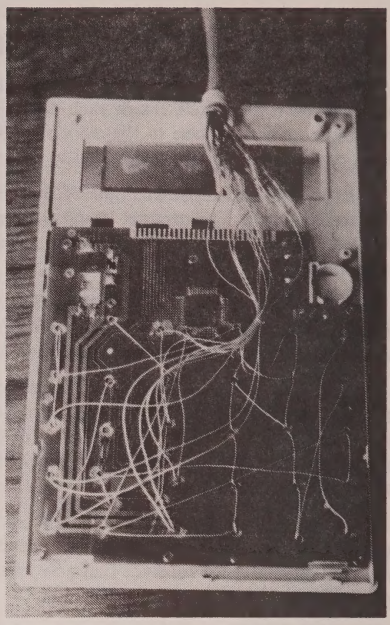
Refer to Figure 1 which is reproduced from the NRD525 Display Board schematic. This matrix diagram is the key (no pun intended) to the design of your remote controller. The matrix allows 32 different switches (keys) to reside on only 12 signal lines. These lines are attached to pins 11, 13, 15, and 17 on IC7 and the anode side of diodes CD9 through CD16. The MEMO switch is attached directly to pins 1 and 7 of IC1. By paralleling the appropriate signal lines we can remotely control any of these switches.

The printed circuit board of the calculator is used only as a platform for the construction of electrical contacts for the keypad controller. Firmly apply a layer of clear, self-adhesive plastic to the side of the PCB that faces the rubber contact sheet, and trim off the excess. This electrically isolates the PCB from the new circuit traces.

Notice the small circular areas or interlocking "fingers" on the PCB located beneath each rubber dome/pushbutton location. Construct a pattern of short, parallel lengths of 1/16" copper tape on the clear plastic, centered over each circular area. The parallel copper strips should be no more than 1/32" apart, and should extend about 1/8" left and right beyond the circular area (original PCB contact fingers). Be certain that each pair of copper strips is positioned exactly; the small conductive pads inside the rubber domes need to complete the circuit when a key is pressed.

Drill a small (1/32") hole at the end of each pair of copper strips. Pre-tin with solder the very ends of each copper strip. Using the NRD525s switch matrix diagram Figure 1 and Figure 2 if you have the EL-334 calculator, solder together the copper strips with wire-wrap wire. Route the wires through the 1/32" holes, across the back of the PCB, and back through a hole to the next copper strip. Link all copper strips together in this fashion, and leave about 6" extra wire connected at the end of each matrix line for attaching to the





shielded cable. It helps to visualize the wiring pattern if you attach the bottom copper strip from each pair to only horizontal matrix lines, and upper copper strips to only vertical matrix lines. Make all connections quickly, with a minimum of solder, so the plastic sheet will not melt. The final product will be a spiderweb of wires on the back of the PCB, with a clean pattern of copper contact strips on the front. Photo at above left shows front side, and photo at above right shows back side of PCB.

Drill a hole at the top (side) of the case half to accept the round, shielded computer cable. Insert the cable into the hole, and make small, neat connections between one end of each matrix line and a conductor of the shielded cable. (Make a note of which matrix line you attach to which conductor.) Insulate each joint with a small piece of heat shrink tubing. A cable-tie around the shielded cable can serve as a strain relief inside the case. Reassemble the entire calculator case with all components, being careful not to pinch any wires.

Leave about three feet of cable between the keypad controller and the sub-D male connector. Assemble the connector and its boot to the shielded cable, soldering matrix line (cable conductor) #1 to pin #1 on the sub-D connector, matrix line #2 to pin #2, and so on. Solder the cable's ground (shield) wire to a pin by itself, adjacent to the last matrix line connection.

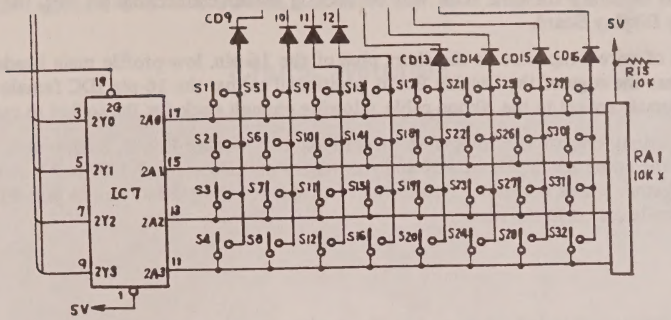
WIRING INSIDE THE RECEIVER

Remove the NRD525's top and bottom covers. Remove the side screws that hold the rear panel to the chassis, and also remove the screws that attach the Ground and Hi-Z antenna terminals. Pivot rear panel toward you and disconnect wiring harnesses from rear panel. Desolder coax from SO239 (panel mount) antenna connector. This frees the rear panel for installation of the keypad's sub-D connector.

Take a deep breath, and drill & file a rectangular hole in the back panel of the NRD525 sufficient to hold the panel-mount female sub-D/IDC ribbon cable connector. A good spot for this connector is just to the left of the Model Number and Serial Number block. Drill two holes for the nuts and bolts to fasten the connector to the rear panel.

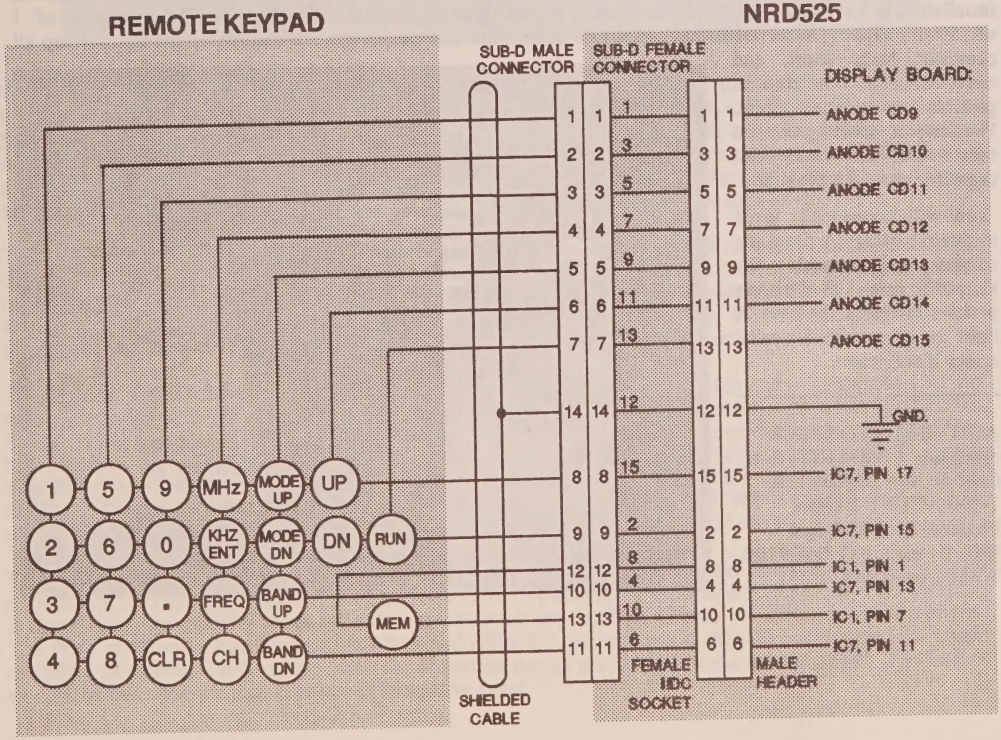
Attach a two foot length of ribbon cable to the connector, with the striped (or otherwise marked) #1 conductor going to the connector's pin #1. Carefully route the ribbon cable between the Ground/Hi-Z Ant. block and the antenna SPDT slide switch, and underneath the receiver's Motherboard forward to the Display Board. Resolder the SO239 connector on the rear panel and reassemble rear panel.

Figure 1



S	NAME	S	NAME	S	NAME	S	NAME
1	TEN KEY 1	9	TEN KEY 9	17	MODE ▶	25	ATT
2	• 2	10	• 0	18	MODE ◀	26	RUN
3	• 3	11	PERIOD •	19	BAND ▶	27	SCAN
4	• 4	12	CLR	20	BAND ◀	28	SWEEP
5	• 5	13	MHz	21	UP	29	CLOCK/TIMER
6	• 6	14	KHz/ENT	22	DOWN	30	MONI
7	• 7	15	FREQ	23	LOCK	31	RIT
8	• 8	16	CH	24	AGC	32	DIMM

Figure 2



Loosen the two screws at the top of the front panel, unsnap the side tabs from the chassis and tilt the front panel/Display Board assembly forward. You will be making solder connections to this, the non-component (reverse) side of the Display Board.

Solder 10" lengths of wire-wrap wire to the short pins of the 16-pin, low-profile male header. Using epoxy, attach the header near the edge of the Display Board, positioned so that the 16-pin IDC female socket can plug into it. Attach the female socket to the ribbon cable, allowing enough slack for the socket to reach the header.

Carefully note the orientation of the integrated circuits on the Display Board. Solder each wire-wrap wire from the header to the appropriate pins of IC7 and the anodes of CD9 through CD15. Route the leads neatly, and bundle them together where necessary. Attach the two leads for the MEMO key to pins #1 and #7 on IC1. Connect the IDC female socket to the header.

CHECKOUT

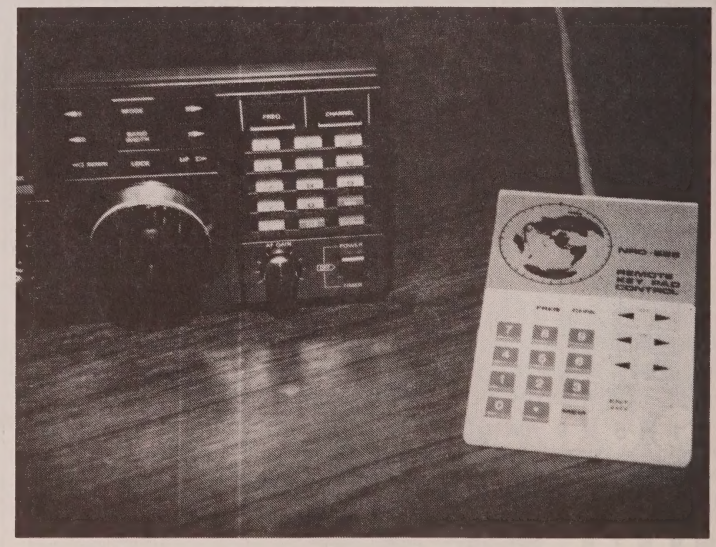
Attach the keypad controller's sub-D connector to the receiver, turn on the radio, and try out all functions. A single, light press of each key should be sufficient to register with the NRD525, with no false or extraneous entries. If the unit does not operate properly, trace the signal path from the controller to the solder connections on the Display Board using a multimeter or continuity tester. Make repairs if necessary.

When all appears to be operating correctly, reassemble the receivers case and enjoy your NRD525 remote keypad controller! I've found that I enjoy using my keypad controller by operating it with my left hand, which leaves the right hand free to adjust the NRD525s main tuning knob and other controls or to make entries in a logbook. I estimate I can change frequencies, memory channels, etc. with the remote controller in one half the time it would take to accomplish on the receivers front panel keypad.

FINAL NOTES

If you find that the keypad causes some digital circuit noise in the receiver, the internal ribbon cable may be picking up interference from the fluorescent display. My unit does not suffer from this, but an identical installation in another NRD525 produced some digital noise on the higher frequencies. The installation of .1 uf (50vdc) capacitors between each signal line connection and chassis ground eliminated the noise. Keep all capacitor leads short, and make connections as close as possible to the joint. Fabricate a short, grounded buss wire and route all capacitor ground leads to it.

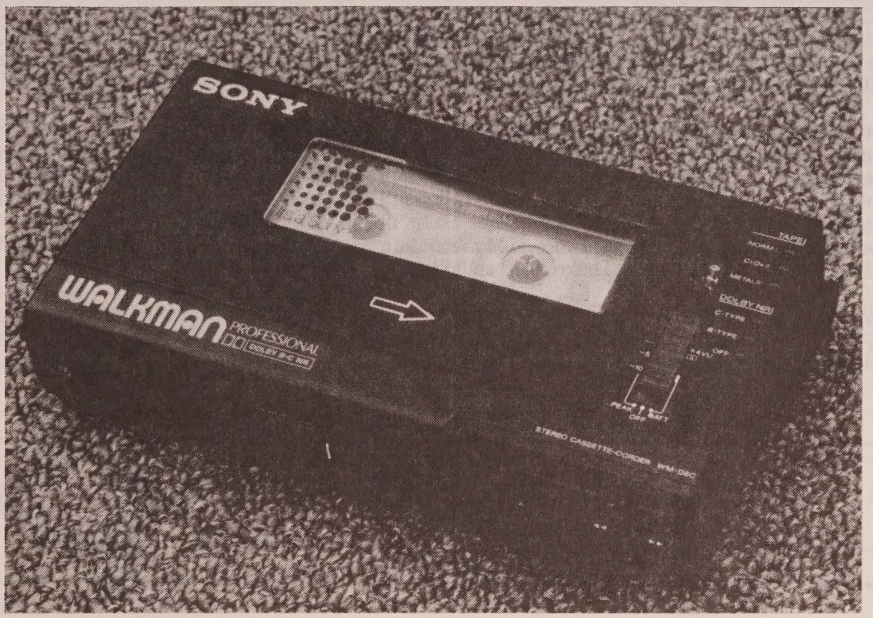
You will occasionally need to remove oxidation from the copper strips inside the keypad case to ensure positive action of the keys. A light rubbing with a pencil eraser is sufficient.



ACTIVE ELECTRONICS: order line 1-800-ACTIVE-4 (outside New England), or 1-800-ACTIVE-6 (New England) M-F 8am-6pm EST. By mail: P.O. Box 9100, Westborough, MA 01581

THE SONY WALKMAN PRO WM-D6C

Chuck Mitchell



What type of cassette deck would you expect to find integrated into a $20,000 stack of hi-fi gear? Perhaps the Nakamichi Dragon or a Studer-Revox studio deck would come to mind. It may be a revelation that the Sony Walkman Professional WM-D6C compares favorably with these high-end cassette machines and appears in many exceptional domestic stereo systems. What will interest the recording DXer is that the D6 achieves this level of performance at a quarter of the cost and size of it's esoteric contenders. It is a reliable and rugged device with the functions necessary for premier DX recording at home or in the field.

The D6 is a proven performer in the hi-fi realm for rendering stunning duplications of albums, compact discs and FM stereo broadcasts. In portable situations it is a valuable tool for recording broadcast interviews, live music, environmental ambience and wild life sounds. I have used the D6 for most of these applications and can verify it's high level of audio reproduction and versatility. If you are searching for a deck to use for the home shack or DXpedition site, the Sony D6 should be a consideration.

The D6 is very compact: a mere 7-1/4 x 1-5/8 x 3-3/4 inches including projecting parts. It weighs 1.41 lbs with it's internal battery pack of 4 AA cells. The shell of the unit is primarily metal with a flat black finish. Features on the Pro have been reduced to a minimum. There are no auto-reverse or memory options. The tape transport control buttons are not soft touch servo-controlled types. They require a firm push to engage a particular function. One touch record is accomplished by engaging the record button on the right side of the deck. The unit will shut down totally when your cassette comes to it's end. While the function controls are not as conveniently laid out as larger tape decks, they are quite rugged and function smoothly.

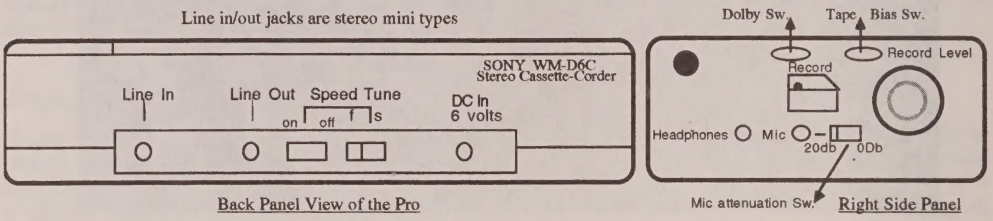
The D6 does not incorporate an automatic level control circuit for record. Input gain is manually varied by a control on the right side panel. Input gain is measured by a string of calibrated LEDs on the top panel. It is easy to keep the record level in the safe zone for most applications. Peaks of +3 to +6 are acceptable. The Pro's electronics have consistently handled off scale meter peaks during unpredictable live music recording situations. I have rarely detected distortion during playback of these intense peaks. The lack of an ALC circuit should not be considered a negative point.

Aside from portability, the Walkman Pro offers other features useful to the DXer. Located on the back panel of the deck is a pitch control. This will yield a speed variance of plus or minus 4%. That small amount of speed change can be a big help in extracting information from a fast talking announcer. There is also a counter located on the top panel.

If you plan to make copies of your tapes it is advisable to switch on the Dolby noise reduction. Both Dolby B and C types are available. Dolby C yields the greatest noise reduction. S/N ratio with C is @ 71 db. It will also produce a recording with exaggerated high frequencies when played back on a deck without Dolby C. The use of Dolby B is still effective, but not as annoying when played back on a non-Dolby deck. I generally switch on B to keep the tape noise down when using a normal bias cassette for everyday DXing.

Input and output jacks are located on the back panel. They are 1/8" stereo mini types. The wiring scheme between the receiver(s) and the D6 will depend on your requirements. The listener can feed one receiver to both tracks via a "Y" adapter. This method will yield a monaural recording. When DX conditions are favorable, the listener can take advantage of the Walkman Pro's stereo tracks by recording two receivers, tuned to different stations, at the same time. (Some Dxers like to tune one receiver to a time signal station and pipe it into one track as a time reference.) My recording scheme sometimes involves feeding the NRD-515 audio into the left track and the Drake R4-B audio into the right track

As with any stereo tape deck, you can feed the individual audio outputs of two receivers, tuned to the same station, to the left and right tracks. By experimenting with different antennas combinations, you may be able to improve the intelligibility of a weak DX station.



Back Panel View of the Pro

Right Side Panel

The Walkman Pro is an obvious choice for the DXpedition fanatic. It's measurements make it possible to even be carried on a backpacking excursion. The D6 can be powered by it's internal replaceable AA battery pack or an external 6 volt source. Four AA alkaline cells will power the unit for about 4 hours in continuous record mode. A 6 volt lantern battery could power the D6 for several more hours. The Pro comes with a fitted soft case. A good investment for field use is the "Travel Satchel" from the Eddie Bauer Company. It measures @ 6" x 2-1/2" x 9" (WHD) and contains several pockets for extra batteries, patch cables and a microphone. The case is constructed of heavy cordura and is padded.

One can monitor with headphones or an external stereo amplifier and speakers. If the latter method is used, one can pan left or right with the balance control to choose the desired signal. I use a compact pair of amplified speakers made by Aiwa. Each speaker has a volume control that allows me to fade up the desired track if a split receiver system was employed. A simple home brew switching box or adapters will be necessary if you choose to single out the left or right track and monitor it in both sides of your headphones.

The Walkman Pro has performed well over the past three years with a variety of cassette types. Maxell XL II-S or Denon HD-7 chrome cassettes are good choices for premium quality recording. The D6 will also accept metal tapes. Sony HF series normal bias cassettes have served my general purpose DX recording needs. Regardless of your tape preference, don't forget to clean the tape path and heads every ten hours of use. Use a cotton swab saturated with a professional head cleaning solution. The solution should be a type that is not damaging to plastic or rubber. It is also beneficial to demagnetize the heads occasionally.

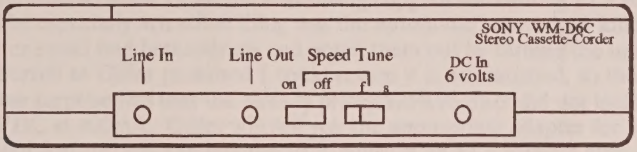
Sony's frequency response specifications in the manual appear to be only average for a deck of this reported quality. I had the D6's frequency response calculated and found that it plays back within plus or minus 3 db from @ 30 Hz to @ 18.0 KHz. (Test tape was a Maxell XLII-S. The test tones were injected at a level -20 db.) Don't be too concerned. As with shortwave receivers, specs can't give a complete view of how a rig will sound in actual use. I have not found a cassette deck that sounds noticeably better than the D6. My comparison listening tests include professional studio decks like the Nakamichi MR-2 and Tascam 122.

These decks report superior specs on paper but don't sound as good as the diminutive Walkman Pro. The bottom line apparatus for testing a deck is the ear. If it doesn't sound better, it isn't better.

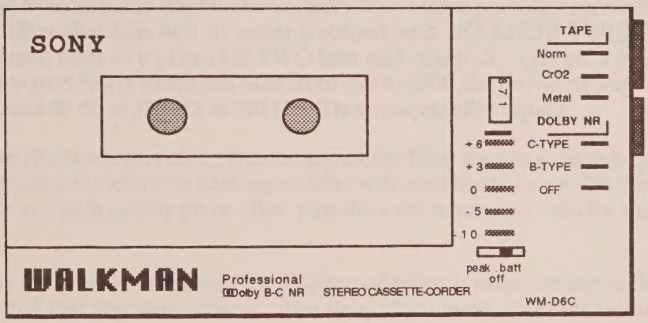
Supplied accessories may vary with dealer. The D6 should be supplied with stereo headphones, patch cables, soft case and batteries. Some dealers supply it with an AC adapter or stereo microphone. In any case, the most important item in the purchase should be a warranty valid in your country! A grey market D6 purchased from a discount dealer may not be provided with a warranty. The Pro can be difficult to locate in the audio marketplace. Below is list of dealers in the U.S. that may stock the D6 or accessories.

Possible sources for the WM-D6C	Telephone
Foto Cell, New York, NY	212-924-7474
47th Street Photo, New York, NY	800-234-4747
Hi-Fi Buys, Nashville ,TN	615-320-1600
Smile Photo, New York, NY	212-967-5900
Bi-Rite Photo & Electronics, New York, NY	800-223-1970
The Eddie Bauer Co. (For the "Travel Satchel")	800-426-8020

The cost for D6 can vary from approximately $295.00 to $400.00. The lower price positions the Pro in the same range as larger Marantz stereo portables and AC only domestic hi-fi decks. The combination of portability, ruggedness and high performance make the WM-D6C a worthy candidate for the recording DXer's needs.



Back Panel View of the Pro



Top View

Abbreviated List of Specifications From the WM-D6C Manual

Wow & Flutter	.04 % WRMS (NAB)	Line out level	.25V >4.7KΩ
Speed tuner variations	+ or - 4%	Headphone output	30 mW + 30 mW
Frequency response (Chrome tape/Dolby off)	40 Hz - 15 K + or - 3 db	Power requirements	6 V dc ,4 AA cells External 6Vdc jack
Total Harmonic Dist.	.9% w/a Sony Metal	Size (WHD)	7-1/4 x 1-5/8 x 3-3/4" 181 x 40 x 95 mm
Mic input	.25mV Low Ω	Weight	1.41lbs 640 g
Line input	77.5 mV 47KΩ		

THE DATONG FL-3 MULTIMODE FILTER

Rowland Archer

INTRODUCTION

Prior to using the Datong FL3 Multi-Mode audio filter, my experience with signal improvement with an audio filter was mixed at best. The typical scenario ran like this: tuning around with the audio filter switched off, I'd find an interesting signal that was bothered by a heterodyne or slop from an adjacent channel. OK, flip on the audio filter and start playing with the controls. Bring down the highpass cutoff to get rid of the interference...and there goes the desired signal at the same time! Notch out the heterodyne...and say goodbye to the useful audio portion of the DX target. After a couple of minutes of tweaking, I'd do an "A/B" comparison between the raw signal from the receiver and the filtered signal...and at best, it was usually a coin toss as to which signal would deliver more useful copy.

I am eternally optimistic, so when I read the advertising copy for the Datong FL3 audio filter I decided to give it a try. The especially attractive thing was the automatic heterodyne killer. Advertisements said this little critter could find heterodynes and notch them out by turning the unit on and pushing a button. Jeanne Ferrell at Gilfer promised I could return it if not satisfied, so the downside risk was under control. One surprise was that the already pricey $259.95 filter did not include an AC adapter; it requires 10-15VDC at 400mA. Gilfer will sell you the appropriate adapter for $15.95. If you don't want the auto-notch feature, you can buy the FL2, which is an FL3 without auto-notch, for $179.95. Check with Gilfer or Electronic Equipment Bank for current prices.

So what do you get from an audio filter that costs more than a good portable receiver? You get a unique, automatic notch filter that kills hets in under a second with NO KNOB TWIDDLING. There's a second, manual notch filter so you can kill TWO hets with one FL3. You get a pair of independent 5 pole high pass / low pass filters which can tune from 200 to 3500 Hz, providing a cut off rate of 40 db in 500 Hz at 2 kHz, and 40 db in 120 Hz at 500 Hz. These are excellent specs.

The skirts of these filters are very steep and the top of the filter response curve is quite flat, as seen in Figure 1. It's difficult and expensive to design a filter with a response curve like this. It takes multiple stages of filtration and high quality parts. This, plus the auto-notch, accounts for the premium price of the Datong FL3.

The flat top of the filter curve means that the FL3 provides linear response across the passband, or the portion of the signal that you want to hear. The steep skirts mean excellent selectivity. You have a much greater chance of eliminating the QRM without eliminating the desired signal than with a filter having less steep skirts.

In practice, if the QRM you want to eliminate is higher or lower in audio frequency than the signal you want to hear, the FL3 can probably get rid of it. If the QRM covers the same audio frequency range as your desired signal, no high pass / low pass filter arrangement, including the FL3, can help.

SETTING UP THE FL-3

Setting up the Datong FL3 is very simple. The speaker or headphone OUT jack from your receiver goes into the INPUT phono jack of the FL3. The output phono jack goes to a 4 to 16 ohm speaker, 4 ohms preferred for max output. Datong includes two cables terminated with RCA phono plugs to fit

the FL3, and tinned leads on the other end. You have to connect the tinned leads to the appropriate connector for your receiver. If you order an FL3, you may want to get the appropriate cable ahead of time from your favorite local electronics outlet.

The FL3 also has a 680 ohm TAPE OUTPUT RCA phono jack, which produces filtered, non-adjustable LINE level audio (as opposed to MIC level) for your tape deck or recorder. I prefer to record raw audio directly from the receiver; this way you get "all" of the signal, including QRM and hets. I run all my receivers through an old Dynaco stereo amplifier, and the output of the Dynaco goes into the FL3. When I'm finished taping my DX session, I can replay the tape over and over, trying different settings on the FL3 until I get the best copy. With this setup you can still use the FL3 to filter audio while you are DXing—but what you RECORD comes directly out of the receiver, ahead of the FL3 and untouched by it.

There's a 1/4" phone jack on the front panel of the FL3 for headphones. When you plug your headphones in, the speaker output is disabled.

OPERATION

Let's review the front panel of the FL3, to get a feel for the controls. From the left, you will find:

Auto notch pushbutton and LED: When engaged, the FL3's automatic notch filter "het killer" is in operation. The het killer sweeps the audio range from 200-4000 Hz, looking for a het. If it finds one, it locks on in less than one second and notches it out. The auto-notch LED lights up to tell you the filter is engaged. The auto-notch uses a voltage tuned 2 pole notch filter in a phase lock loop system. The notch is 40 db down, and it's very sharp and effective.

If there is more than one het present, the one that gets notched is simply the first one encountered in the (audio) frequency sweep search. This may or may not be the louder of the two. You can use the manual notch to eliminate the other one. If there are more than two annoying hets, try again tomorrow!

In practice there are two minor annoyances with this otherwise super feature: a quiet "whooshing", sweeping sound is heard as the het killer searches for a het to kill. This is subtle enough that you might

not notice it; if it bothers you, you can just turn it off until you encounter a heterodyne whistle. In fact, if you tune in ECSSB most of the time you will probably want to leave the auto-notch off until you need it, so you don't accidentally notch out a het that indicates the presence of a desired weak signal.

The second problem may indicate a need for adjustment of my unit. The overall volume of the signal going into the FL3, and thus into your headphones, has to be a bit high for my taste before the het killer will lock onto the het. I've never found a het that couldn't be notched out with the FL3. I do find the total volume needed before the het killer will engage to be louder than a comfortable listening level.

Low and high pass filters: The heart of the FL3 is a very versatile set of audio filters. There are two independent 5 pole filters, one low pass and one high pass, that can work in three different modes: SSB, CW, and RTTY. SSB mode really means "voice", as it works fine for AM mode signals, too. In fact, according to Datong, it's even useful for SSTV reception.

The four pushbuttons just to the right of the on/off pushbutton let you choose between the various filter modes. There are three different SSB modes: SSB alone, SSB + NOTCH, and SSB + PEAK. The notch/peak settings switch in a separate, manually tuned, 2 pole filter. This filter is 200 Hz wide at 6 db down, and tunes from 200 to 3500 Hz. If the station you want to hear is bothered by two hets, you can eliminate one with the auto-notch filter and the other with the manual notch filter. The SSB + PEAK setting is not for listening, but instead is a tuning aid for the manual notch. Select SSB + PEAK, tune for maximum strength of the het, then select SSB + NOTCH, and voila!, the het is gone.

On the righthand side of the front panel there are three knobs, calibrated from 200 to 3500 Hz. The function of these knobs depends on the configuration of the SSB/CW/RTTY mode pushbuttons.

In SSB mode, the middle knob controls the cut-off frequency of the low-pass filter. In other words, frequencies lower than the indicated frequency are suppressed. The rightmost knob controls the setting of the high-pass filter; frequencies higher than indicated are eliminated. Both of these controls are smooth and precise with minimal backlash. The knobs are on the small side, but this is not a problem.

The left-most knob controls the manual notch or peak frequency. It is calibrated from 200 Hz to 3500 kHz in 500 Hz steps except for the first step, which goes from 200 Hz to 500 Hz.

In CW mode, the low and high pass filters are combined with the peak filter to provide a 12-pole signal with a peak on the desired CW tone. Alternatively, you can choose CW(2) mode, which eliminates the peak filter and just gives you the low and high pass filters. The function of the tuning knobs changes in CW mode: the middle knob shifts the center frequency of the filter, and the righthand knob controls the width of the passband. In CW mode, the frequency range tuned is half that of SSB mode: 100 to 1750 Hz. This combination of filters is very effective at digging out a single CW tone from a pileup, as long as the interfering signals are of different audio frequencies at the input to the FL3.

RTTY mode superimposes a notch at the center of the passband. I am not set up to receive RTTY so I can't comment on the FL3's effectiveness at digging RTTY out of the QRM.

There are two ways to BYPASS the FL3 in operation; when you turn the power off, your receiver audio passes straight through to the headphone jack. The second approach is to leave the power on but press the "SSB+PEAK" and "SSB" buttons together; this leaves the FL3's electronics in line but gives you level response, i.e. no amplification or attenuation.

IN PRACTICE

I am very impressed with the effectiveness and quality of the FL3. When I ordered this filter, I knew Datong had a good reputation; now I know why. It's expensive but I think it's worth it. This audio filter gets used instead of gathering dust. It's especially good at eliminating high pitched splatter from nearby signals and is deadly on hets. It doesn't distort the desired signal and the steep selectivity skirts let you dial up the exact audio passband you want to hear. Highly recommended.

TYPICAL PERFORMANCE DATA

Input impedence:
5000 ohms

Nominal overall gain:
unity

Low-pass and high-pass filters
Frequency range:
200 to 3500 Hz, linear tuning
Minimum stop band rejection:
40 dbs
Rate of cut-off:
40 dbs in 500 Hz at 2 kHz
40 dbs in 120 Hz at 500 kHz

Notch and Peak filter
Frequency range:
200 to 3500 Hz, linear tuning
Notch width at −6 dbs in "SSB + NOTCH" mode:
200 Hz
Notch depth:
30 dbs

Bandwidth range in "CW(2)" and "RTTY" modes:
100 to 1750 Hz at −6 dbs

Bandwidth range in "CW" mode:
70 to 700 Hz at −6 dbs

Power output:
2 watts into 8 ohms with 18 v supply
1.5 watts into 4 ohms with 10 v supply

Output protection:
The output stage (LM380) is short-circuit proof and over-dissipation proof

Supply current:
50 mA zero volume
350 mA max. output

Supply voltage:
10 to 20 volts DC. Protected against reverse polarity

Size:
184 mm wide × 153 mm deep × 44 mm high (7.2 × 6.0 × 1.7 inches)
Feet add 10 mm (0.4 inches) to height

Weight including packing:
1100 grammes (39 ounces)

Finish:
Anodised aluminium wrap-around case. Panels printed white and yellow on black

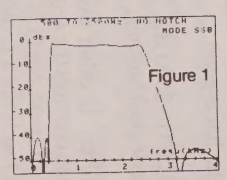
Accessories:
Supplied complete with input lead and output lead (Phono to bare end)

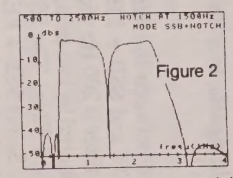
Optional extra:
Mains Power Unit for 220-240 volts AC. Order Model MPU or MPU/1.

FREQUENCY RESPONSE CURVES

Computer generated response curves for Model FL2 are shown below to illustrate the results obtained in the various operating modes. The graphs were obtained by solving the overall filter transfer function. Actual filters may differ slightly from the curves shown due to component tolerances.

DATONG ELECTRONICS LIMITED
Clayton Wood Close,
West Park
Leeds LS16 6QE
Telephone: (0532) 744822 (2 lines)





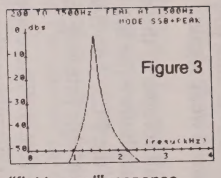
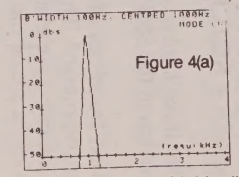
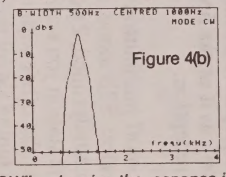


Figure 1 *"SSB" – showing the steep skirts and the "flat-topped" response. Here only the low- and high-pass filters are in operation.*

Figure 2 *"SSB + NOTCH" – same conditions as figure 1 but the notch filter is also in circuit and set to 1500 Hz.*

Figure 3 *"SSB + PEAK" – conditions are identical to figure 2 but now the PEAK/NOTCH filter is set to PEAK instead of NOTCH. This mode is normally used simply as an aid in tuning the notch filter.*





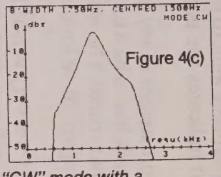
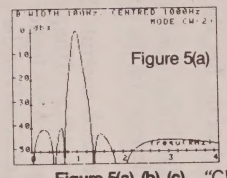
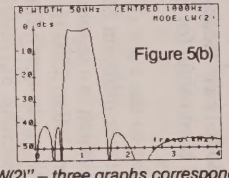


Figure 4(a), (b), (c) *"CW" – showing the response in "CW" mode with a bandwidth setting of 100 Hz, 500 Hz and 1750 Hz). Note the "peaked" response and very steep skirts.*





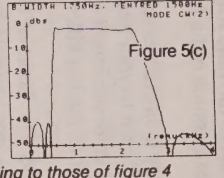
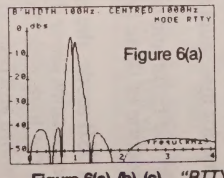
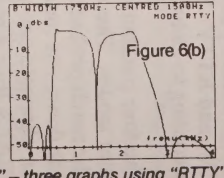


Figure 5(a), (b), (c) *"CW(2)" – three graphs corresponding to those of figure 4 except that "CW(2)" mode was selected. Note the "flat" rather than "peaked" response.*





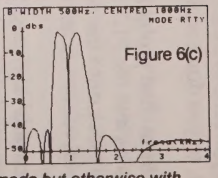


Figure 6(a), (b), (c) *"RTTY" – three graphs using "RTTY" mode but otherwise with same bandwidth and centre frequency settings as figures 4 and 5.*

features

THE LIBRARY AS A DX REFERENCE TOOL

Don Moore **John Bryant**

It's doubtful many DXers are aware of how much useful and interesting hobby-related information can be found in public and university libraries. Libraries aren't the place to find "hot" DX news, but they do have a wealth of technical and general background information which can be very helpful. This article will focus on university libraries familiar to the authors, but most of the ideas apply to public libraries as well. Even if you don't live near a good university library, don't despair. Thanks to the miracles of computer communications and inter-library loan, you can get most of these materials from even the smallest public library. But more on that later.

INFORMATION PLEASE

Librarians are the most important research tools in the library. They put somebody behind the information desk for a reason, so don't be afraid to ask questions. In fact, most libraries employ research or reference librarians whose job is to help people find things.

Whether looking for books or magazines, the first place to start is the card catalog. Many libraries today have computerized their card catalogs. But these computer systems are user-friendly and easy to learn. In addition to looking for a specific title or author, doing a subject search with words like "radio" and "broadcasting" can turn up books that might not be on the shelf at the moment. A list of Library of Congress subject headings, useful for subject searches, is included in the appendix. These are useful in doing "Boolean" searches, e.g., telling the computer to find all entries that contain both "India" and "broadcasting."

Call number searches are a good way to find books that may not be on the shelf at the moment. Depending on your library's computer system, you may be able to scroll through all the books with a HE8689 call number. A list of general call number areas of interest to DXers is included in the appendix.

It is beyond the scope of this article to delve into the details of each publication cited. Considerable further information concerning maps, atlases and general "people and places" is found in "Reference Resources for the Advanced DXer" in Proceedings 1989.

GENERAL HOBBY REFERENCES

Many libraries do shelf some of our standard references. Medium sized public libraries are usually well-stocked with ham radio books. Most have a few ARRL handbooks and subscribe to at least one ham magazine. But, unless your public library is really large, you're not likely to find much on SWBC. But, the first step in using the library as a DX tool is to check out the local public one. Besides looking at the books, take a look at their periodicals too. Along with the current ones, find out if they have old copies of magazines like POPULAR ELECTRONICS. Many university libraries, and even some public ones, get the World Radio TV Handbook (WRTH). This could be convenient for the DXer on a budget who wants to skip buying the WRTH for a year - just copy down the current info most interesting to you. Usually the current issue is in the reference collection and can't be checked out. The older issues are often in the general stacks. If you want to see an older edition and your local library doesn't have it, use the inter-library loan service. They can get you a copy of any edition, or photocopy a specific article usually at minimal cost. One exception to the "hot" DX news, is that some libraries subscribe to FBIS and BBCMS. Other SW publications sometimes pop up too, such as Passport to World Band Radio (PWBR), Richard Wood's Shortwave Voices of the World, or some of Gerry Dexter's Tiare Publications books.

MAPS AND ATLASES

This is one area where major libraries really shine. Most have a good collection of maps and atlases, usually in a special Map Room. If you can't find that little Bolivian town you heard last night, probably the best place to look is a gazetteer, a list of geographical place names and their coordinates. Sometimes it's in the back of an atlas, sometimes it's a separate volume. The best gazetteer around today is found in The New International Atlas by Rand McNally, published in several editions, beginning in 1980. Not only is the gazetteer exceptional, this atlas is one of the few that shows provincial boundaries in places like Indonesia, Central America, and Africa. THE NEW INTERNATIONAL ATLAS, however, does not have very good coverage of South America, especially jungle settlements. The Great World Atlas by the American Map Corporation and most Hammond atlases have four to five times more jungle settlements. The Times Atlas (of London) is also considered excellent by many DXers.

With a little luck, you might be able to locate a specific country gazetteer. The US Department of Defense publishes these for numerous countries, including El Salvador, Honduras, Costa Rica, and Indonesia. They list anything that has a place name - village, brook, hill, island, province, etc. The Indonesian one is two very thick volumes! Other country or regional gazetteers are published privately. The Bishop Museum in Hawaii publishes an excellent one for the Pacific Islands. There are also some very good country and regional atlases. The Atlas of Africa is one of the few that show provincial boundaries in most African countries. Sometimes atlases published in, say, Brazil or the USSR have especially detailed maps of those countries.

Frequently flat maps are more detailed than atlases. Most library map rooms have cabinets full of maps published by foreign governments, oil companies, universities, and the National Geographic Society. The US Defense Department Mapping Agency publishes an excellent selection of topographical maps from around the world, which many libraries stock. In fact, these are inexpensive, and the map librarian should be able to supply you with the order forms.

BROADCASTING BOOKS

Since we are such a small and crazy minority, it's easy to forget that we're not the only people interested in broadcasting. It is an academic subject too, and there are a lot of books about the subject. Entire books have been written about broadcasting in Papua-New Guinea, the Arab World, and the history of radio in countries like Australia, Brazil, and Venezuela. If you specialize in DXing a particular area of the world, you may find the background information very helpful and even fascinating! True, some of these are written in a very academic style, but if nothing else, they may have some good pictures.

What kind of broadcasting books are available? Donald Browne's Limits of a Limitless Medium is "must" reading if you really want to understand why international broadcasting exists. It's a very readable and balanced book with lots of historical background, closeups on international broadcasters, and interesting references in the extensive footnotes. Soley and Nichol's Clandestine Radio Broadcasting is a very detailed history of clandestine radio up to publication in 1987, with chapters divided by era and geography. The Central American and Cuban chapters are excellent. The International Handbook of Broadcasting Systems, edited by Philip T. Rosen has 24 chapters, each focusing on a different country. It gives a good basic picture of broadcasting around the world.

There are many more such books, and a sample list is included in the bibliography. Most books in this category will include their own bibliography of still more interesting reading.

TECHNICAL BOOKS

Since radio, television, and electronics are major fields of study in electrical engineering, any major university library will have many radio-related technical texts in three main subject areas: Electronics, Antennas and Propagation.

You might be surprised to find out how many of the most admired "technical" minds in the hobby hold degrees in Humanities or Law or English, and are self-taught, creative "electronic geniuses." Of the technical books listed in the bibliography, Shrader's Electronics Communication and Orr's Radio Handbook are understandable by anyone, if they are studied rather than scanned like a paperback.

However, if you wish to avoid in-depth study in electronics, propagation may interest you. The primary source of information on ionospheric propagation, the one source quoted by all following authors, is Ionospheric Radio Propagation originally published in 1965 as National Bureau of Standards Monograph 80. That book is available to each of us at virtually any major library with a Government Documents section. It is highly recommended. The other three propagation books mentioned in bibliography (Gassmann, Folkestad and Newman) contain critical information not widely known in the hobby.

A number of recently published antenna books are available to us within the hobby itself. These include the ARRL Antenna Handbook and Antenna Compendium (vol. 1 and 2) as well as several other very good offerings. Most modern professional antenna texts focus on UHF/VHF or VLF. The few that do deal with SWBC focus on transmitting antennas. None of the professional antenna texts which we found seemed useful. This tendency was not true in scholarly papers discussed elsewhere in this paper.

PEOPLE AND PLACES

Finally, let's leave radio behind, and just look at culture. Many of us find it helpful to understand the culture and history of our favorite DX targets. Increasing your awareness and understanding of a DX target area prepares you to recognize and understand what you're hearing when you hear it. It's what separates senior DXers from not-so-senior DXers. Here, again, libraries are useful; just pick your favorite country and see what they have on it. There are thousands of general books and dozens of travel guides that can be useful to DXers. Ohio State University's library has about one hundred feet of shelf space just on Peru.

One of the best books in the People and Places category is The South American Handbook. This annual travel guide has over 1300 pages of detailed information on towns and cities throughout Latin America. Anyone who seriously DXes Latin America should be familiar with this book. Although somewhat dated, John Gunther's Inside South America and Inside Latin America are good places to start reading about the general history, politics, and culture of Latin America.

Surely the best series of "cultural" guide books in English are the Insight Guide series published in Singapore. They are handled in the US by Prentice-Hall. These guide books attempt to be a 'single source' of cultural/historical/climatological and general geographic information for the astute traveler and are written by a collection of usually local experts chosen by the publisher for that particular country or topic. In the Insight Guides there is very little coverage of hotels, restaurants, etc. The Insight Guides to Indonesia and Bali (13th edition) as a whole are the best truly cultural guides that exist on those areas. Some of our Latin aficionados will enjoy the recently published Insight Guides to such places as Brazil, Mexico and Argentina. Current prices for each of these informational goldmines is around $20.00 US.

The most complete "people and places" travel guide for Indonesia is the Indonesian Handbook by Dalton. They have just introduced a Bali Handbook as well. The latest edition (the 4th, 1988) is over 1000 pages long! Finally, the "Cabot" line of travel guides is not well known in this country because they are published in Switzerland and cost over $100.00 each. John Bryant, an East Asia expert, swears that the China Guide by Cabot is the best in the business. The South American version is equally recommended by Don Moore.

For a few more ideas in this category, see our bibliography, and check out the one in the Irian Jaya article in Proceedings 1988. Of course, browse the shelves at your local library.

University libraries as academic and scholarly institutions usually have a lot of books which focus on specific topics in specific countries. These books may be written in English or in the country's native language. Sometimes it's worthwhile to check out the indexes in these books for entries like "radio", "broadcasting" and "Voz de", but it's a lot like looking for a needle in a haystack. Still, some interesting things do pop up. For example, Ohio University's library has a sort of "who's who" for La Paz, Bolivia, published by a local commercial organization. It includes several station owners. Many major libraries also have collections of international phonebooks. Call up that rare Peruvian and ask for a QSL or just photocopy the ad as an enclosure.

Another general area of interest to DXers is language. If your university has a good Linguistics department, you may find dictionaries, phrase books, grammars, etc for dozens of languages. If you're having a tough time verifying a particular country, try throwing in a few words of their local language. Don couldn't get LeSotho to QSL until he sent them a report with a few LeSotho phrases like "please", "thank you", and "I like Radio LeSotho". If you do this, DO NOT try making up your own complete sentences in the language. Grammar rules and vocabulary can do funny things if a person doesn't understand how to use the language. Stick to stock words and phrases from the book.

Finally, a good number of excellent People and Places books have been generated as companion books to recent TV series on educational TV networks around the world (PBS in the United States). These include Ring of Fire by the Blair brothers about their travels in Indonesia, and several books published by the Cousteau Society, most recently the incomparable Journey to Papua New Guinea. Other TV companion books highly prized by DXers include Disappearing World (originating with Grenada TV of Britain), The Amazon Rain Forest (Cousteau), and numerous books on China.

PERIODICALS

As with books, there are professional broadcasting periodicals that relate to our hobby. Medium wave DXers especially are already familiar with Broadcasting and Broadcasting Yearbook. Academic journals, such as The Journal of Broadcasting or Communications Quarterly also have articles which relate to our hobby. For example, there's Robert Gwyn's "Rural Radio in Bolivia: A Case Study" in the Spring, 1983 Journal of Communication.

One way to find these articles is to locate a journal and begin scanning each issue's table of contents for interesting titles. Another way is to check a periodicals index. There are specific indices which list articles in particular fields. Such Indices include Communications Abstracts, Middle East Abstracts and Index, and International African Bibliography. Usually these include a short paragraph summarizing each article. Some indices are available on CD-ROM, which allows you to do a quick computerized search for articles with key words. Ask the research librarian for guidance here. Of course, don't forget the basic Reader's Guide, which lists radio articles in old issues of Popular Electronics and other magazines.

TECHNICAL PERIODICALS

The major radio amateur magazines (QST, CQ and Ham Radio) are carried in most major libraries. In recent years the low band and QRP movements have rekindled interest in receiving antenna design, receiving peripheral equipment as well as in our mutual interest in Tropical Band propagation. Back issues of these magazines are bound into book form and usually are retained permanently. Great reading!

TECHNICAL PAPERS

Although frightening to some neophytes, the technical papers collected in a major library can prove a bonanza for any who will give them a chance. Most of these papers are collected and published as "books" much like fine tuning's Proceedings. In fact, many are named "proceedings" or "transactions," etc. The Institute of Electronics and Electrical Engineers (IEEE) publishes whole series of "Proceedings" papers presented at conferences and collections of other papers published monthly as "Transactions."

For casual perusal, IEEE's Transactions on Antennas and Propagation and IEEE's Transactions on Broadcasting are highly recommended. Most libraries also contain large sets of similar papers from sister professional organizations throughout the world. In fact, there are masses of technical papers dealing with subjects of vital interest to DXers.

Faced with such a myriad of excellent sources, it is probably foolish to browse among the bound volumes of technical papers. Luckily, there are at least three abstracting digests available in our area of interest. They are Electrical and Electronics Abstracts, Engineering Information, Inc., and Engineering Index. All three categorize technical articles from many sources by subject matter and all three provide a several sentence-long condensation of the papers' contents. Of the three, our favorite is the first. This multi-volume set has sections on : Electromagnetic Waves; Antennas and Propagation; Communications; Earth Sciences. "E and E" has things sorted both by specific subject and by categories and covers virtually everything written in English in a periodical or compendium from CQ, to the most obscure international scholarly tome. These abstracts make hard work easy!

Words of Encouragement and of Words of Caution: Some people assume that a reader must comprehend, fully, every aspect of a technical article to gain benefit from reading it. That is not true. Authors generally put--in clear English--an abstract of the basic ideas of the article at the beginning of their article. Usually, there is a similar clearly written narrative conclusion. Many of the charts and graphs are also comprehensible even if some of the mathematics and technicaljargon in the body of the article may be rough going. Pick out an area of interest and jump in, the water is fine! ONE VERY LARGE CAUTION, HOWEVER: It is very easy to misunderstand or misuse information and concepts which you do not fully grasp. Be careful! If you have a question, find an expert (write the author) and politely ask if you understand correctly.

Our favorite antenna article, so far, is "Television Receiving with Papaya Tree Antenna." Go for it!

GENERAL PERIODICALS

For most of us, there are probably more general interest magazines we want to subscribe to than we can afford. Whether your interest is Smithsonian, National Geographic, or Islands, your local library might have the one to which you have not yet subscribed.
Most university libraries get a number of overseas newspapers and magazines. Usually these are kept in a separate periodicals or reference room, with older editions bound and placed in the regular stacks. Where these come from will depend on the university's international focus. Finding radio items in these is difficult but they are there occasionally. For example, Ohio University gets a newspaper from Botswana that prints a daily program schedule for Radio Botswana.

It would be impossible to look through all the overseas publications most libraries get. But, if you have a particular geographic interest, you might want to check out publications from that area. Whether it's Bogota's "El Tiempo" newspaper or the magazine Inside Indonesia, there's up-to-date information on what's happening in your country of interest. The librarian should be able to help you find a list of publications from or about a specific country or region.

NOSTALGIA RADIO

A major library is also a gold mine of both technical and non-technical information on the early days of radio. In the non-technical area, many major libraries have complete bound volume sets of virtually ALL of the early day radio hobby magazines. At Oklahoma State, these included: Radio Craft (from 1934 forward), Radio (an early ham mag from 1934 forward), Popular Radio (1923-27), Wireless World (1945 forward), Radio News (1930-38) and Radio Age. You can have a "natural high" by pulling the Nov. 1922 volume of QST and read all about the Wave Antenna recently invented by Harold H. Beverage of RCA!

Many of us involved in restoring hollow state technology go to great lengths and a good deal of expense to find badly needed circuit diagrams and trouble shooting/repair manuals. The Oklahoma State University Library has COMPLETE sets of the famous Rider's Perpetual Troubleshooter books (Vol V to Vol XXIII) as well as all Sam's Photo Fact Service and the Most Often Needed Radio Diagrams as published by Supreme. Some people are paying as high as $20 for single diagrams which are either available at their own public library or which can be obtained virtually free through inter-library loan!

While you are at the library, you might look at the Yearbook of Wireless Telegraphy and Telephony of 1916. Mr. Marconi's picture is shown. He is formally posed wearing an Italian Army uniform (Lieutenant in the Signal Corps, of course!).

AUXILIARY SERVICES

Many people think of a library only as a container for books. In fact, even the smallest libraries offer many other services of real value to DXers. For instance, a growing number of municipal libraries have mini-computers (usually Apples and PC clones) for free use by their patrons. You usually have to attend a 10-15 minute introductory briefing prior to your first use of these machines.

Many public libraries offer large collections of audio and video tapes to their patrons. If you would like to hear Andean huyano or Indonesian gamelan music without static, try a major city library.

Even very small neighborhood libraries now are hooked up to "OCLC." The On-line Computer Library Center is a data base of library holdings. It can be searched on a local, regional or national level for material by author or it may be searched in a "subject" mode. OCLC is housed in the PC that you see near the circulation or reference desks. Many libraries allow patrons to search the database themselves; others insist on doing it for you. Either way, its the best video game in town, and free to boot!

The auxiliary service most useful to radio enthusiasts is Inter-Library Loan. This is a usually free service and gives patrons of even the smallest libraries access to almost any book or periodical held in most North American and even some European libraries. All you have to do is fill out a form giving the normal bibliographic citation of the book in question (author, title, publisher, date). The library staff then uses a computer to search an international data base. They are able to identify the nearest library holding your book, and your library receives the book by mail. NOTE: the same routine works with magazine articles. In that case, after the bound volume is found by the computer search, the distant library photocopies the article that you want (often for a small fee) and mails the copy to your library.

Lastly, it is possible to ask the library to do "key word" searches of bibliographic data bases. THIS IS NOT USUALLY A FREE SERVICE. This service consists of entering "key words" into the computer and sorting a commercially prepared data base to find articles or books of specific and narrow interest to you. This is a very sophisticated service and can be very expensive. For instance, we asked to have a search made for high frequency radio wave antennas (so-called Beverage antennas) and got a $30 print-out that included every article written in english which included both the words "radio" and "wave" in the abstract! It was a looooong print-out and useless! A better way for us neophytes to search for articles is the use of the Electrical and Electronics Abstract books.

CONCLUSION

You can see how impossible it is to keep up with even one segment of the information explosion related to our hobby. To us, that is one of the best aspects of the hobby--it is truly open-ended and combines both technical and humanistic/cultural interests at whatever ratio each of us desires.

One highly recommended way to keep this article and your sources of information current is to subscribe to The Journal of the North American Shortwave Association. The Journal contains several excellent columns dealing with many of the subjects contained in this article. Further, it carries a column called "Listener's Library," edited by John Bryant, containing reviews of several interesting resources each month. Though dealing primarily with books, it also covers magazines, individual articles, videos and computer software of special interest.

For North American readers, you generally have "every right" to use the libraries at your state's tax supported colleges and universities, whether you are an enrolled student or not! You certainly may browse shelves, read, or photocopy things of interest. Most of these libraries also allow citizens of their state to check out books as well, though sometimes this privilege must be arranged in advance.

For those us who don't know university libraries well, they do beat public libraries except in the very largest cities. Libraries do have tremendous resources. However though reference librarians are there to help you, they won't do your work for you. To get anything near maximum benefit, you have to spend a lot of time learning the ropes. Browse for many hours. It is also worth taking the several-hour-long "course" or "extended tour" that most university libraries offer to incoming freshmen.

Well, we hope you're convinced that there is a ton of information out there for us. We've probably also convinced you that you would have to be nuts to go to all this work. We won't argue with that! Still, why not give it a try? Sometime, on a free day, drive to a nearby large university or public library and check it out. Take this article along and see what you can find. Also, don't forget to take along a lot of note paper and a pocket full of change for the copy machine - you're going to need it!

APPENDIX ONE

LIBRARY OF CONGRESS SUBJECT HEADINGS:

For a precise breakdown, look under 'radio' in the Library of Congress subject headings book.

radio
antennas
propaganda
stations
international broadcasting
radio antennas
communication
radio program
radio stations
radio journalism
amateur radio stations
receivers and reception
radio in (cntry/region)
radio stations, foreign

LIBRARY OF CONGRESS CALL NUMBERS:

Note that different libraries may have the same book catalogued in a different section.

BV656: Catholic radio.
BV2082: Missionary radio.
D810: WWII radio propaganda.
DS: General books on Asia and the Mid East.
DT: General books on Africa.
DU: General books on Oceania.
F1200-F3800: General books on Latin America.
G1: Geography, including NATIONAL GEOGRAPHICs.
GR-GT: International folklore and customs.
HD9999: Radio supplies industry.
HE7600-HE8700: General broadcasting, esp. 8689-8699.
LB1044: Radio in education.
P87-P100: Mass communications, incl. some radio.
PJ-PL: Mid East, Asian and African languages
PN1990-PN1991: General broadcasting.
PN4784: Radio journalism.
QC9725: Auroras.
TK5700-TK6655: Technical & radio history. Incl. WRTH.
TL696: Aeronautical beacons.
UG610: Military radio.
VK397 & VM325: Maritime radio.

DEWEY DECIMAL LISTINGS

621: Radio and Electronics
914-919: Worldwide travel books.
940-990: Worldwide history books.

APPENDIX TWO
BIBLIOGRAPHY

The following list is by no means complete, but it should get you some idea of what's out there beyond the traditional bounds of hobby radio. More sources on specific topics can be found in the bibliographies and footnotes in these books and articles.

BROADCASTING BOOKS

ABC Press & Public Information Department. The Constant Voice: Radio Australia's 30th Anniversary 1939-1969.

Alisky, Marvin. Latin American Media: Guidance and Censorship. Iowa State University Press, 1981.

Almeida, Mauro. Comunicacao de Massa no Brasil. Edicoes Jupiter: 1971.

Armas Chitty, Jose Antonio. Historia de la Radiodiffusion en Venezuela. Edicion de la Camara Venezolana de la Industria de Radiodiffusion, 1975.
A general history, with short closeups on 30 stations, most of which are or have been on shortwave. Some pictures.

Asamoah, Ernest, ed. Golden Jubilee July 1935-1985: 50 Years of Broadcasting in Ghana. GBC Golden Jubilee Publicity & Literature Committee, 1985.
Lots of black and white photos.

Ballon, E., et.al., eds. Radio y Communicacion Popular en el Peru. Centro Peruano de Estudios Sociales, 1987. 319p.
Radio in social development, with chapters focusing on Catholic stations such as R. Quillabamba, R. Maranon, & LV Selva. Fascinating, but no pictures.

Barnouw, Erik. A Tower in Babel. Oxford University Press, 1966.
_____.The Golden Web. Oxford Universtiy Press, 1968.
_____.The Image Empire. Oxford University Press, 1970.
These three books are a set, each subtitled "A History of Broadcasting in the United States:" the first is from the beginning to 1933, the second from 1933-53, and the third after 1953.

Bonavita Federico, Maria Elvira. Historia da Comunicacao Radio TV no Brasil.

Boyd, Douglas, ed. Broadcasting in the Arab World. Temple University Press, 1982.

Broadcasting In.....
There are books on numerous countries under this name, many published by Sage Publications. Among those found are Nigeria, Papua New Guinea, India, Guyana, Mexico, Australia, Peninsular Malaysia, and Eastern Europe. Check this out on your library's computer or OCLC.

Browne, Donald R. International Radio Broadcasting: The Limits of the Limitless Medium. Praeger, 1982. A classic.

Childs, Harwood & John B. Whitton. Propaganda by Shortwave. Princeton Univ. Press, 1942.
Shortwave history.

Commonweallth Broadcasting Association Handbook. London, 1976.
Info and pictures on stations throughout the commonwealth.

Danilov, A. Broadcasting Pirates. Moscow: Progress Publishers, 1981.
English reprint of an official Soviet book about radio pirate problem in the USSR.

Fejes, Fred. Imperialism, Media, and the Good Neighbor: New Deal Foreign Policy and United States Shortwave Broadcasting to Latin America. Ablex, 1986. 193p.
An interesting look at early US shortwave & the beginnings of the VOA. Lots of references.

Ferraz Sampaio, Mario. Historia da Radio e da Televisao no Brasil e no Mundo. 1984.

Fox, Elizabeth. Politics and Mass Media in Latin America. 1988.

Frederick, Howard H. Cuban-American Radio Wars: Ideology in International Telecommunications. Ablex, 1986.

Fundacion Standard Electric Argentina. Historia de las Comunicaciones Argentinas. F.S.E.A., 1979.

Gil, Gustavo, ed. De las Ondas Rojas a las Radio Libres. Barcelona, Spain: 1981.
This is about pirate radio in Europe.

Hale, Julian. Radio Power. Temple Univ. Press, 1975.
Emphasis on SW as a propaganda tool.

Head, Sydney, ed. Broadcasting in Africa: A Continental Survey of Radio and Television. Temple Univ. Press, 1974. 453p.

Herz, Daniel. A Historia Secreta da Rede Globo. Tche Editora Ltda., 1987.
A muckraking look at Brazil's REDE Globo which, after the US's big three, is the 4th largest radio/TV net in the world. Unfortunately is in Portuguese and has no photos
Katz, Elihu & George Wendall. Broadcasting in the Third World. Harvard Univ. Press, 1977. 305p.
Lent, John A. Broadcasting in Asia and the Pacific. Temple Univ. Press, 1978.
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INTERNATIONAL MEDIUM WAVE DXING FROM WESTERN NORTH AMERICA

Bruce Portzer

Medium wave DXing is one of the most challenging parts of the DX listening hobby. Like tropical band listening, you're trying to hear stations you were never intended to hear. You are, after all, outside the station's target audience. And like tropical band DXing you're also trying to hear programs intended only for a local or regional audience.

Unlike the higher frequencies, the medium wave band is very crowded. Tune around on any night and you'll mostly hear stations within a couple hundred miles of your location. A few more distant stations will also be there, but by and large, you'll hear the one, two, or three nearby stations on each channel. So unless you have an unusually clear frequency, or unusually good propagation, the DX stations are masked by closer stations. To add to the challenge, medium wave signals are normally propagated via the E-layer, which means they are more severely attenuated and require more hops than shortwave signals, which reflect off the much higher F-layer. Nonetheless, it is possible to receive medium wave signals from every continent if you know where and when to listen.

Proceedings '89 had an excellent article on International Medium Wave DXing from the midwest by Fritz Mellberg. This article continues in a similar vein by looking at international medium wave DXing on the west coast of North America.

Medium wave DX can be difficult to hear in western North America. In recent years it has become even more difficult. For reasons subject to great debate, reception of foreign medium wave DX has not been what it used to be. Part of the reason is the FCC assigning many new stations on what had been clear channels, which has affected the west more than any other part of the country. Another reason is the present peak in the sunspot cycle, although this has historically had less effect on medium wave DX than might otherwise be believed.

Technological changes have also had their effect. Broadcasters seem to be putting out wider bandwidth signals with more punch than they used to, resulting in more interference from the increased number of stations, who are mostly on the air 24 hours a day. Light dimmers and other sources of electrical noise are likewise masking some of the weaker stations. Finally, an unexplained force seems to be at work: a natural phenomenon which makes medium wave signals much weaker than in previous years.

Nonetheless, it is still possible with knowledge and perseverance to hear a fairly respectable number of countries on the medium wave band. As with most DX endeavors, you need the right receiving equipment and knowledge of which stations to listen for, and when to listen. A good location is also important, as we'll see a little later in the article. But sometimes you don't have very much choice in the matter.

For a combination of reasons, most of the foreign DX on the west coast (as reported to "DX Worldwide" in the IRCA DX Monitor) comes from somewhere across the Pacific. Here in the Pacific Northwest, about 90 percent of my loggings in recent years have been of stations from the Far East, Pacific Islands, and Down Under. Another 5 percent have come from Mexico (not counting the 3 or 4 major borderblaster stations), with the remaining 5 percent from the rest of the world. In southern California and elsewhere near Mexico, the Pacific stations make up a smaller portion of the total, but the share is still substantial. The main reason is lack of interference: stations in Europe, Asia, Africa, and the Pacific operate on a nine kilohertz spacing (i.e. 531, 540, 549 kHz, and so on), instead of the ten kilohertz spacing utilized in the Western Hemisphere. As a result, the DX slips in between the domestic interference. Latin American stations, on the other hand, generally operate on the same channels as U.S. and

Canadian stations, and have to fight their way through the much closer, much stronger domestic stations.

GETTING STARTED

There are several things you need to successfully log foreign medium wave stations: a good location, good receiving equipment (both receiver and antenna), good band conditions, and knowledge of when to listen and what to listen for. All are of equal importance.

Location: Ideally, you should live outside a major metropolitan area. Better yet, outside the primary coverage area of the stations in the nearest major city. If you want to log some really good transpacific DX, then you should live in a rural area along the coast (which basically includes all the coastal areas north of Eureka, California). Aside from being outside a big city, geography matters little as far as hearing transatlantic stations or Latin American stations, although you will be much better off hearing the latter the farther south you are. We aren't all fortunate enough to live in small towns on the coast, so we have to either 1)make DXpeditions to some place with less interference, or 2) make the most of our equipment, stay informed on potential targets, and take advantage of DX openings when they do occur. (With respect to DXpeditions, see Nick Hall-Patch's article elsewhere in this edition of proceedings). Speaking from experience, a DXpedition to the Washington or BC coast is the next best thing to DX heaven. Stations which are unthinkable in Seattle, have come in quite regularly next to the ocean.

Equipment: It almost goes without saying, you'll need a good receiver and good antenna to hear more than a handful of countries. I've heard Cuba on a car radio in southern California, and Japan in Seattle on a Portable radio with no external antenna. But for much more than that, you should have a communications receiver and a good directional antenna. Some communications receivers are better than others. The best are those which have good sensitivity, selectivity, and overload immunity on medium wave. Unfortunately, some receivers which are very good on shortwave are poor performers on medium wave, because they are deficient in one of the three categories. Remember, you're trying to hear very faint signals, which oftentimes are a kilohertz or two off from a powerhouse a few tens or hundreds of miles away. You'll need everything your receiver can deliver. For the record, DXers have reported good results on the Icom R-70/71, the NRD-515/525, and the Kenwood R-1000/2000/5000. The Yaesu FRG-7 is likewise a solid performer, if outfitted with mechanical filters, but the later FRG-7700/8800 are not as good. Several older, tube type receivers have remained big favorites among foreign MW DXers, especially the Hammarlund HQ-180 series and SP-600, the Collins R-390A, and the Racal RA-17. A good antenna is essential most of the time. I have heard excellent TP DX using only 50-70 feet of wire a few feet from the ocean, but that was because I was in a great location (Kalaloch campground at Olympic national Park). To consistently pull in good DX you'll need either a loop antenna, or a Beverage antenna. There are several good loop antennas on the market, or you can make one using plans available from the IRCA and NRC. Loops have several benefits: they are generally compact, they can be rotated to null interference, and they can be tuned to a particular frequency. Beverages have the best directionality, and can pull in stations that can't be heard any other way, but you obviously need to find a piece of real estate a couple thousand feet long.

Conditions: Band conditions play a critical role in determining what you will hear. The DX just won't get through unless the path is viable. In general, high latitude paths, such as paths to Europe and the Far East are best heard:

- During September, October, November, and March.
- When the ionosphere has been quiet for a while. Ideally, the A-index should have been below 5 for several days, although an A-index less than 10 is almost as good.
- During the low point in the sunspot cycle (although several DXers have questioned whether the sunspot cycle matters).

A darkness path between you and the station is, of course, essential. I've heard Asian stations over 3 hours after local sunrise, but such receptions

obviously aren't the norm. Europeans, when they make their rare appearances, can be heard from a couple hours past local sunset here, until around their local sunrise, with no set pattern of when they peak. Asian openings tend to vary as to when the DX peaks. Sometimes there is a peak around their local sunset. Sometimes there's a good peak around our local sunrise, sometimes there's a big enhancement in the middle of the night with little activity around sunrise. After 25 years of DXing, I still haven't detected a pattern in the activity.

Stations from the Pacific Islands and Australia can be heard throughout the year, but they are best heard during the Equinox periods (March, April, September, and October. The summer months can produce some good openings into this part of the world. Unfortunately, there are also nights of little activity. Enhancements at our local sunrise can often be very pronounced, especially at coastal locations. In the space of a few minutes, weak signals from Down Under can suddenly fade up to remarkable levels - and continue to come in well until 40-60 minutes after sunrise.

Latin American stations can be heard throughout the year, although the summer months produce noticeably poorer results than other times of the year. There are two "conditions" which help Latin American stations come in better:

- An absence of strong American and Canadian stations on the frequency. This can occur if there aren't many domestic stations on the channel or one or two which can be easily nulled by a loop or Beverage antenna. It can also occur if the normally dominant station is off the air for maintenance. HJCY-810 in Bogota, for example, can sometimes be heard when KGO in San Francisco is off for maintenance. Unfortunately, KGO only goes off 3 or 4 times a year, with little advance notice, so you have to be either persistent or lucky.

- During auroral conditions. High geomagnetic activity at these times tends to attenuate higher latitude signals more than lower latitude signals, or to actually enhance the lower latitude signals. This sometimes lets a few Latin stations slip past the usual interference.

Knowledge: In most of life's endeavors, you're more successful if you carry around a lot of information. Ideally, it should all be in your head, but there's a practical limit of how much you can actually retain. Nonetheless, you'll be a more successful DXer if you learn and retain as much as you can about your DX target areas. This includes the frequencies, location, slogan/call/network, bearing, fade in and fadeout times, sign on and sign off times, and similar information. Much of this knowledge is acquired through experience, the rest is acquired through reference material. Your best sources of information include the World Radio TV Handbook, the IRCA "Foreign DX Reference", various IRCA reprints, and the "DX Worldwide West" column in IRCAs bulletin DX Monitor. About 90 percent of the west coast's international medium wave DX loggings are reported to IRCA, so it's by far your best source of current information on the topic.

With these thoughts in mind, let's take a look at stations which have been heard on the west coast in recent years. The following summaries are based on Phil Bytheway's "Foreign DX Reference", which lists all the foreign DX reported to IRCAs "DX Worldwide" columns during the past three years, and the issue(s) in which they were reported.

TRANSATLANTIC STATIONS

This is by far the toughest area to hear in western North America. Signals from this part of the world need to travel long distances via high latitudes, and are therefore subject to considerable attenuation. Europeans have been heard a few times in recent years. Norway-1314 has been the easiest of late, thanks to their running 1200 kw into an antenna pointing west. Other possibilities include other northern Europeans, including Germany-756, Holland-747, and Britain-1215. Southern Europe is rare, but not impossible. Nick Hall-Patch's logs of Bulgaria and Turkey in the late 1970's are legendary examples. Africans haven't been heard here in ages, due generally to poor conditions. In the late 1970's, and early 1980's, Senegal-765 was probably the most frequently heard African, followed by Guinea-1404 and Algeria-891.

TRANSPACIFIC STATIONS

Asia provides some very good DX possibilities. Japan leads the pack, particularly the high powered NHK stations. Several South and North Koreans, Chinese, and Soviet stations are also often heard. A couple times a year, Taiwan, Philippines, Sabah, & Thailand are also known to come in. Far East stations are heard best in the early fall. The first decent receptions usually occur around Labor day. Far East stations continue to show up when conditions are right up to sometime in October or November. After that, they almost disappear until around March, when they reappear for a few weeks before winding down for the season.

Far East openings are often limited to particular frequency ranges or locations. Openings limited to the upper end of the dial have been fairly common lately, especially during mid winter. Korea-1566 and China/USSR-1476 usually have the best signals during these openings. At other times, only certain parts of the Far East can be heard. Openings limited solely or almost solely to Japan are particularly common.

Far East stations generally do not start fading in until around 0900 or 1000 UTC, depending on conditions and the time of year. Depending on the particular opening, they usually remain in until just after sunrise. The earliest fade in I know of was at about 0600 (JOIB-747). Fade outs two hours after local sunrise here have been known to occur on several occasions, and fade outs three or more hours after sunrise have occurred under very rare circumstances. For some reason, these late fadeouts seem to only occur at coastal Beverage antenna sites.

South Pacific stations can be heard throughout the year, although reception is generally best around the equinox periods. I've found this to be a very interesting target area. One reason is the large number of potential DX countries which can be heard. Another is the surprising number of strong signals for their power outputs. The programming can also be quite interesting, especially on some of the exotic island stations. Watch for especially strong signals around the stations' sunset time or your local sunrise.

ALASKA: In the Northwest, you've got several possibilities, including KTKN-930, KRSA-580, KYOK-560, KYAK-650, KBBI-890, and KFQD-750. Another interesting possibility is "SQM", a weather station & beacon on 529 in southeast Alaska. The best time to try for them is just before your local sunrise during the winter. None are very easy, but you'll bag one of the above eventually just by being there. Further south and east it will be tougher. Your best bets are the ones on the clear channels.

AUSTRALIA: There are many stations to choose from, especially if you're using a coastal Beverage antenna. The strongest signals come from the ABC outlets such as 3LO-774, 4QD-1548, 3GI-828, and 4RK-837; these can be heard inland in urban areas. 3LO was even heard in Georgia a couple years ago. There are lots of commercial stations which are heard by the coastal Beverage crowd: 4MK-1026 is the most reliable, followed by 2MC-531, 2GB-873, 4RR-891, 2UE-954, 2KY-1017, 2UW-1107, 2WL-1314,and 2RE-1557. The most exciting target of all are the stations on 1620 and 1629 which broadcast for the visually impaired. Although only 500 watts, they have been heard and confirmed as far east as Ontario and Massachusetts. Unfortunately, they may be moving to standard medium wave channels in the near future, so try to log them while you still can. Overall, about 60 different Aussies have been reported to IRCA's DX Monitor during the last 3 or 4 years, so you've got lots of stations to shoot for.

CHINA (PRC That Is): Your best bet is the outlet on 1476, which mixes with the Russian. These two are among the half dozen most frequently heard Asians. Be careful with the language, as the Russian carries Chinese as well. Runner up is the Japanese foreign service on 1044. The Yanbian station on 1206 is also sometimes heard during their Korean broadcasts. Other stations reported in recent years include CPBS stations on 576, 756, 828, 837, 927, 995, 1017, and 1035.

CHINA (Taiwan): Difficult to fair. You can probably get either the 738, 1143, 1458 or 1521 outlet if you try hard enough and conditions are good.

FIJI: This is one of several countries with no shortwave outlets. If you want to hear it at all, you'll have to do it on medium wave. The programming on Radio Fiji can be rather interesting at times: local ads, DJs in English, Fijian, and/or Hindi, and anything from hard rock or country western to Hindi music. Just about all the outlets listed in the WRTH have been heard here in recent years, but those on 558, 684, 774, and 891 are heard most often.

GUAM: Very difficult. KGUM-567, KUAM-612 and/or KTWR-801 are heard every 2 or 3 years.

HAWAII: KIKI-830 seems to be the best bet up and down the west coast, partly because it's on one of the few relatively clear channels left. KPUA-670 is often heard where you can get past KBOI. KUAI-720, KGU-760, KAIM-870, KNUI-900, KHVH-990, and KMVI-550 are also good bets depending on your local interference. Hawaiians fade in at about their local sunset when conditions are very good, but are best from a couple hours past their sunset until your local sunrise. Like most foreign DX, the Hawaiians aren't in every night but with a little effort, you'll bag a couple without too much effort. Hawaiians can be heard throughout the year.

JAPAN: The strongest signals you'll hear are from the high powered NHK outlets: JOAB-693, JOIB-747, JOBB-828, JOUB-774, JOAK-594, and JOGB-873. These 6, with 300 or 500 kw of power, are among the easiest TPs of all. The language is distinctive enough, but you can catch the time signal ...- at the top of the hour, and maybe an occasional NHK mention to confirm their identity. Some of the NHK programming is quite interesting; especially the English language lessons where they discuss life in the U.S. When conditions are good, you'll be able to hear many more NHK and commercial stations, including some relative low powered outlets. NHK audio has been heard on 1584 more than once, and the most powerful thing listed is 100 watts! Several commercial stations can also be heard, including JOKR-954, JONR-1008, JOHR-1287, and JORF-1422.

KIRIBATI: Tarawa-846 is not hard to hear on coastal Beverage antennas, and can sometimes be heard in metropolitan areas with loop antennas.

KOREA (South): HLAZ-1566 is consistently one of the best Asians here, with religious programs in several different languages. HLCA-972 is a respectables second. For a real treat try the jammer on 1053, which sounds like the sound effects from a grade Z 1950's sci-fi flick. Other likely targets include stations on 603, 864, 891, 1035, and 1467.

KOREA (North): Pyongyang on 657 is by far your best bet. It can be heard when other Far East stations are in reasonably well.

MALAYSIA: Kota Kinabalu-1475 is heard a few times each season during the broadcasts to the Philippines in Tagalog at 1030-1300 UTC. Reception of this one is often best during the spring.

MARSHALL ISLANDS: Two stations have been heard by folks with coastal Beverage antennas recently. WSZO-1098 on Majuro with programming aimed at the local population, and AFRS-1224 on Kwajalein mostly with US network feeds for Americans stationed on the island. Not many people know it yet, but the Marshalls are now an independent country.

NEW CALEDONIA: Noumea-666 is sometimes there during south Pacific openings. It has been heard both on DXpeditions and occasionally in the big city.

NEW ZEALAND: I used to hear this country quite regularly in Seattle, but for some reason, they've been much more difficult in recent years . On coastal DXpeditions, it's relatively easy to hear several "zedders", unless the opening is entirely for high latitude stations. The best bets are the Radio New Zealand stations on 1008, 1035, 1044, and 1098, as well as the National Program stations on 819 and 756. Be forewarned that many New Zealand stations are moving to FM in the next few years, and their channels may become vacant.

PAPUA NEW GUINEA: This is somewhat tough to hear, but if you make enough pilgrimages to the coast, you'll eventually hear it. The current best bets are Madang-864, Radio Enga-1494, and Radio West Sepik on 1593. I can't recall anyone hearing them in a metro area recently.

PHILIPPINES: This is a toughie, but a few stations have poked through in recent years. VOA-1143 and DXCC-828 are the most likely targets. Sometimes some other obscure station will be picked up by someone, on a practically one-time-only basis.

SAMOA (American): WVUV-648 is sometimes picked up at coastal locations, although CISL-650 gives them a rough time.

SAMOA (Western): 2AP on 540, 747, 1251 and 1404 are sometimes heard on the coast.

SOLOMON ISLANDS: Moderately easy on coastal Beverages and feasible farther inland. Watch for the 1035 outlet when you're out at the coast. This station is sometimes heard in metropolitan locations, too. The 945 station is occsionally heard on this side of the Pacific. The shortwave parallel on 5020 can be used to confirm the identity of both outlets.

TAHITI: Papeete-738 can be heard at coastal sites. Audio can be difficult due to KCBS-740 interference. A heterodyne from this one can often be heard up and down the coast.

THAILAND: If it weren't for VOA-1575, this country would almost never be heard in North America. It's reported 3 or 4 times per year.

TONGA: A3Z-1017 has been getting out very well since they replaced their transmitter. Listen for lots of a capella native music,plus talk in English and Tongan. This one is moderately easy on coastal sites and can be heard on good equipment in the cities.

TUVALU: 621 is usually tough to separate from the domestics on 620, but a few people have done it on coastal beverages in recent years.

USSR: The station on 1476 is one of the best heard Asian signals, with programs in Russian and Chinese. Listen for the "Midnight in Moscow" chimes at the top or bottom of the hour. The outlets on 549, 585, 648, 720, 1008, and 1251 are also regularly reported. There are also several longwave stations which present challenges of their own, check 153, 180, 189, 234, 245, and 281 kHz when medium wave reception is good.

VANUATU: Port Vila-1125 is very rare, but there has been at least one reception during the past year or two.

WALLIS ISLAND: 1188 is very tough to separate from KEX-1190, but one or two fortunate souls have been able to pull it in.

LATIN AMERICA

Mexico can be heard on your tooth fillings throughout the west. After that it gets a little more difficult. A few Cubans sometimes put in respectable signals, as do a handful of other Caribbean stations. Central America can also be heard from time to time, as can the northern South American countries. The more southerly South American countries were heard up to the early 1980's but haven't been reported lately.

ANGUILLA: This country is blessed with a station on 1610, Caribbean Beacon, whose only interference is the ten watt Travellers Information stations. Watch for it with religious broadcasts during the evening or after 0900 sign on.

ANTIGUA: The Caribbean Lighthouse on 1165 has been reported in recent years. Your chances of hearing it depend on its weak signal getting past the 1160/1170 interference.

BAHAMAS: ZNS3-810 is sometimes heard in southern California during rare KGO silent periods or with KGO carefully nulled out (with either a loop or Beverage antenna). Good luck on this one.

BELIZE: Radio Belize has been heard a lot less often since moving to 830 from 834 in late 1984. Nonetheless, it does sometimes poke through during the evening or just after 1100 UTC sign on.

CAYMAN ISLANDS: Radio Cayman on 1205 and 1555 are two more splits sometimes reported out here. The best time to try is just after their 1100 sign on, although winter evenings are also a possibility.

COLOMBIA: A few years ago this country was relatively easy to hear. Since then, the AM dial has gotten much more congested. Now you'll probably have to wait for a clear channel pest or two to make a rare silent period. Your best bet is HJCY-810 if KGO goes off. Other possibilities include HJJM-660, HJCU-730, HJED-820, HJKC-850, HJAI-1040 or HJCN/HJAT-1100 if a strong US or Canadian station is off, or if you're using a Beverage antenna pointing that way.

COSTA RICA: Try TICAL-530, R Rumbo, whose main interference is the Travellers Information stations and a couple low powered Canadians. Another good bet is TISHB which operates in the range of 1125-27. TIHB-730 was also heard once in California last season.

CUBA: This is probably the second easiest Latin country after Mexico. Watch for the high powered Radio Taino stations on 830, 1040, 1100, and 1160 during the evening. I've even heard the first two on a car radio in southern California. Your chances of hearing them obviously depend on the co-channel interference. Radio Progreso-640/670, Radio Rebelde-670 and Radio Reloj-940 also sometimes are heard in the western U.S., especially on Beverage antennas. Cubans aren't audible all the time, but when they're in, they are often quite strong.

DOMINICA: The 595 outlet was last heard a couple years ago.

ECUADOR: About once a year someone hears Ecuador. Most of the time it's on a Beverage antenna. Radio Superior (HCRS9) on 890 is the most frequently heard. Other recent receptions include Radio Sucre on 700, Radio Caroussel on 660, and Radio Huancavilca on 830. All have major interference to contend with.

EL SALVADOR: Radio Nacional-655 is heard occasionally.

GRENADA: The outlet on 535 has been heard only a couple of times in recent years. Best time to try is just after sign on.

GUATEMALA: Another one where you have to hope someone else is off the air. TGN-730 is possible in California. TGRT-670 is heard occasionally.

HONDURAS: Radio Moderna (HRLP16) on 820 has been heard a few times in the past couple years. On a Beverage you may be able to pull in one or more others.

JAMAICA: Radio Jamaica on 700 in Montego Bay was heard in southern California on a Beverage antenna last season. This is a tough one, thanks to KFAM, WLW, CKRD, et al.

MEXICO: If you live in southern California, put your ear next to the toaster and listen for talk in Spanish. Further north you'll have to use a radio. Best signals everywhere are from 50 kw (or more) borderblasters like XETRA-690, XEPRS-1090, and XEROK-800. There are about 700 stations in Mexico, so DXing this country can be an end in itself.

NETHERLANDS ANTILLES: PJB-800 sometimes is heard through the XEROK and Canadian interference.

NICARAGUA: R Sandino-750 used to be an easy catch but it's been overwhelmed by all the new domestic stations. Best bet now is the 555 outlet, if it's still around.

PERU: R Union-880 has been heard here, but it's rough now due to all the domestics operating all night on 880. R Nacional-854 may be possible, but it hasn't been reported lately.

ST KITTS: Radio Paradise on 825 can sometimes be heard on the west coast, if you can get past one of the many adjacent interference sources.

TURKS AND CAICOS: Caribbean Beacon on 1570 has made it to the west coast. It's basically a matter of sneaking past the Canadian interference. A Beverage would probably make this one a good bet.

VENEZUELA: YVNA-660 was heard before KTNN went 24 hours. YVLT-830 has been heard in Seattle at 0400 UTC s/off, on what is still a relatively open channel. YVQT-1110 has been heard in California, as has YVOZ-1200.

VERIFICATIONS

In general, the rules for medium wave reception reports are the same as for those to Tropical Band stations. A report in the station's native language is a wonderful idea, but except for Latin America, is not usually necessary. A taped report is a good idea, and in many cases is the only way to produce convincing program details. Return postage (preferably mint stamps or a US dollar) is also strongly recommended, and in some cases mandatory. The verification policies of medium wave stations are similar to their tropical band counterparts. Only a small percentage of Latin American stations will answer but those that do will be highly prized. Caribbean and Pacific Island stations can be good verifiers when they want to be, but many of them need to be prodded. Most Far East, New Zealand and Australian stations are good verifiers; notable exceptions include the Russian and North Korean networks. South Korea's KBS network likewise has a strict non-verification policy.

CONCLUSIONS

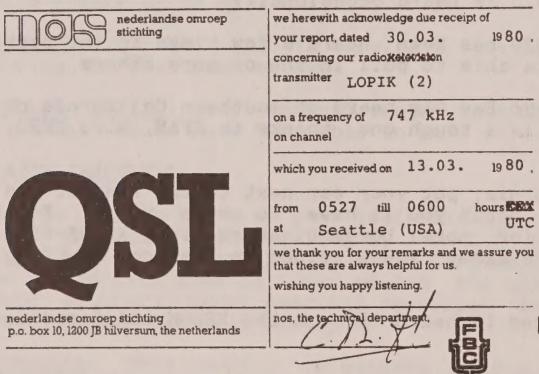
Medium wave DXing can be a major challenge, but the rewards make it well worth the patience and effort you put into it. The next time you have a good tropical band opening, pull yourself away for a few minutes to scan the medium wave band. You may hear some really good DX.

FOR MORE INFORMATION

The International Radio Club of America and the National Radio Club have a wide range of reprints and publications on medium wave DXing. Both clubs make these publications available at moderate costs. For lists of available publications send a dollar to the following addresses:

IRCA Goodie Factory, c/o Steve Ratzlaff, 295 Pettis Ave., Mountain View CA 94041

NRC Publications Center, P.O. Box 164, Mannsville, NY 13661


nos nederlandse omroep stichting

QSL

nederlandse omroep stichting
p.o. box 10, 1200 JB hilversum, the netherlands

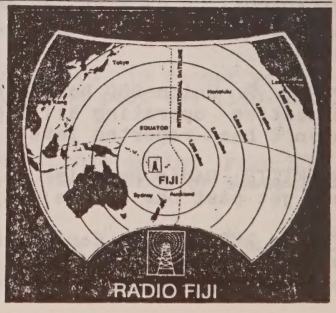
we herewith acknowledge due receipt of your report, dated 30.03. 1980,
concerning our radio~~transmission~~
transmitter LOPIK (2)
on a frequency of 747 kHz
on channel
which you received on 13.03. 1980,
from 0527 till 0600 hours ~~GMT~~ UTC
at Seattle (USA)
we thank you for your remarks and we assure you that these are always helpful for us.
wishing you happy listening.
nos, the technical department

FBC

Fiji Broadcasting Commission
The Voice of The Islands

Dear Listener
Thank you for your report on the reception
of station RF II Rakiraki
broadcasting on 1467 kHz
at 2335 GMT on (date) 20/1/83
We are pleased to confirm your report ☑
Unfortunately there is not enough information for us to confirm your report ☐

General Manager
Broadcasting House
Box 334 Suva, Fiji.



DXING ON THE ROAD

A Compendium of Advice, Tips and Techniques

Rowland Archer

INTRODUCTION

Our radio hobby has a nice tie-in to travel. Even a small change in geographical location can make new stations audible. One time zone east or west of your QTH exposes you to a new grayline. Travelling to the opposite coast radically changes DX opportunities. A business trip or vacation to another continent can give you a chance to hear new radio countries, or enjoy local quality reception of your favorite DX targets.

All this sounds good on paper — then it comes time to travel. You stroll over to your shack and stare at the array of equipment: receivers, antenna tuners, tape decks, audio processors, headphones, and bookshelves full of reference material and old DX bulletins. What should you bring along? How should you pack it? Will power be a problem? The answers will depend on wnere you're going, how you're getting there, how long you're staying, and what you want to hear.

Whatever your plans, you should get organized well in advance, and this article is full of ideas that will help you. You probably know the feeling of arriving at your vacation Shangri La and discovering that you forgot to pack a bathing suit or bring your fishing pole. It's a pain, but you can buy or borrow one at your destination, and your vacation isn't ruined. However, just try buying a spare **DSWCI Tropical Band Survey** or **Passport to World Band Radio** if you forget to bring a station list along — that's not so easy!

Recognizing that DXing on the road has special requirements, I wrote up my experiences in the *DXer's Forum* column in the **NASWA Journal**. Response was good, and we decided to expand on the subject for **Proceedings '90**. The interest in this topic is strong, and I'd like to thank all the contributors for helping out with a great variety of information. The following compendium combines the new contributions with items from my Journal article, contributions to last year's Proceedings, and a contribution to the Journal by Dan Sheedy.

PACKING

KNAPSACKS: My travelling DX shack fits easily into a knapsack, with room left over for a few books and some snacks for long bus rides. The radio and tape recorder are each wrapped in a shirt or pair of pants, both to protect them from being kicked around, and to assure me of dry clothes upon reaching my destination (bus drivers aren't always efficient at covering rooftop luggage with the canvas tarp). *—Don Moore*

SHOULDER TOTE BAG: My whole kit weighs about twenty pounds, and fits in a shoulder tote bag. I wrap the radio and tape recorder in terry-cloth towels for two reasons: first, it cushions impact, and second, if something should get spilled into the bag, the machines won't suffer from it. *—Gerry Bishop*

CASSETTE CARRYING CASE: Cassette tapes are the first choice for take-along music, and a wide variety of cassette cases are available. Included among these are a type of soft-sided travel cases that have a removable, rigid plastic insert that accepts 30 to 40 cassettes.

With the plastic insert removed, these sturdy Nylon (or leather) travel bags can easily transport a Sony 2010 receiver (or similar), AC power adapter, reference books, notebook and pen, and other such supplies.

Last year I spotted the "Musicmovers" MM-300 series of cassette cases at a local drug store chain on sale for $6.99. I bought three for storing and transporting DXpedition supplies. It wasn't until my next vacation that I thought of using one as a DX travel bag. Measuring 13-1/2 by 9-1/2 by 5 inches, the MM-300 series of bag has a main compartment, two smaller pouches, a detachable shoulder strap, and a briefcase-like soft "rip-stop" Nylon handle.

These bags are well made and incorporate a layer of sheet foam rubber in between layers of Nylon cloth on the sides. This helps protect the contents.

With careful packing, it is surprising how many DXing accessories can fit into this case. In addition to the supplies mentioned above, I can bring along Walkman-type headphones, small cassette recorder & a tape or two, and the very compact AC-1 active antenna made by Inline Components Inc. I've replaced the AC-1's 9vdc power adapter with a 9vdc transistor battery & clip, which is mounted on the side of the AC-1's enclosure. This way I can leave the bulky power adapter at home.

I've noticed other similar cassette cases made out of leather, which sell for around $20.00. These may or may not have the internal foam padding. Whichever type you purchase, I'm sure you'll find these converted cassette cases to be a good low cost alternative to DX travel bags sold through SW supply houses. —*Guy Atkins*

ULTIMATE UNDER-SEAT BAG: For years, I've searched for the perfect under-seat bag—a light/strong bag that would allow me to carry my 525, MAP unit, log books and references right thru security and on the plane with me. Finally, I have found it: The Back Door Convertible Suitcase/Rucksack is specially manufactured by world traveller and travel book author (Europe Through the Back Door, etc.) Rick Steves. Over 15,000 of these beauties have been made/sold in the past few years by Europe Through the Back Door, Inc. (120 4th Ave. N., Edmonds, WA 98020. Phone 206-771-8303). At 9" x 21" x 13" it's the absolute maximum allowed carry-on size for most airlines. The dimensions are also perfect for the 525, the MAP, the headphones and various logs. That is enough of a load that the "secret compartment" shoulder straps are VERY welcome. The Back Door bag is made of rugged water-resistant Cordura nylon (1000 Denier). It converts easily from a smart looking suitcase to a handy backpack. It has a large main compartment and two outside pockets that are perfect for logs or reference items. And when you're not using the shoulder straps for the backpack, you don't have to worry about them—they hide away in the zippered secret compartment in the back!

Back Door Convertible Suitcase/Rucksack

Rick himself lives out of one of these bags for 3 months each summer. The perfect

bag for the Travelling DXer includes these features:

1. Handles on top and side for easy carrying as a suitcase.
2. A "secret" compartment for rucksack shoulder straps.
3. A clip-on shoulder strap for use in the suitcase mode.
4. Water-resistant and machine-washable tough material.
5. Lockable perimeter YKK zippers for easy access.
6. Four colors available (gray, navy, black, burgundy).
7. Extra nylon stuff bag included.
8. Two extra elastic-topped interior compartments.
9. Two-year manufacturer's guarantee.

Price: $65.00 (no tax or postage add-ons)

I am hesitant to recommend a non-radio commercial item, but this is simply the best underseat bag for our kinda folks....period! and the price is right, too! *—John Bryant*

PORTABLE COMPUTER CARRYING CASE: I travel mostly by air, and I prefer a bag that I can carry on to the plane. I found a portable computer carrying case works well. It's a cloth-covered bag, 12"W x 14"H x 5"D, padded, with a front and back compartment, pockets for cassette tapes, and a convenient carrying handle. I put the receiver, tape recorder, and active antenna in one compartment, and the reference materials, cables, spare batteries, and blank tapes in the other. A stiff-sided bag with padding will protect your equipment much better than a soft nylon carry-all sack. If you have to ship your gear as checked baggage, a metal case such as those used for photographic gear is best. These are expensive. An alternative is to use plenty of padding in a hard-sided suitcase. *—Rowland Archer*

BEAN BAG: I only take carry-on luggage. I bring a Sony 2010, the supplied 20' of wire, MDR20 headphones from Sony, a clock, a notebook, and a couple of pens with highlighter attached, my DX target list, and the MW frequency and Latin American sections from the WRTH. This all fits in an L L Bean "Deluxe Sportsman's Seat Bag" with plenty of space left for clothes, toilet articles, tickets, etc. *—Dan Sheedy*

TRAVELLING

LEGALITIES AND CUSTOMS: If you're travelling abroad, do some homework first to make sure your radio gear is legal at your destination. Some countries place restrictions on what their citizens can hear, and you could unintentionally run afoul of such laws. Many country guide books include information on travelling with radios, tape recorders, and portable computers. The most up-to-date source of information is the embassy of the country you will visit.

Many countries have stiff import and export duties on electronic equipment. Take the receipts for your equipment with you so you can establish where you purchased it. It may help to register the equipment with customs on entering the country and clear it with them on leaving. Check with the embassy for guidance before you start your trip. *—Rowland Archer*

BORDERS: I have never had a problem taking my Sony across borders. Few customs officials have unpacked my bags enough to uncover it, and those who have ignored it. Yet, as I frequently cross borders at out-of-the-way places, I sometimes worry about what the officials will think of it. Digital push-button radios could become a lot of things in the minds of semi-literate border guards raised on a steady diet of James Bond movies. Before crossing a border, I always preset the memories to local AM stations at the crossing point. Hopefully that will calm anyone who finds the radio suspicious. *—Don Moore*

POWER

BATTERIES: Hotel rooms are chronically short of spare electrical outlets. My solution is to use battery-powered equipment. I carry extra batteries, as I don't want to run out of power at 4AM local time in the middle of a great listening session. I don't like the weight of the spare batteries, but then I can dispense with heavy AC adapters. I do like the quick setup — no scrounging around the hotel room rearranging lamps to free up outlets, or discovering that my extension cord is too short. *—Rowland Archer*

VOLTAGE CHECK: For short trips it is possible to carry enough batteries to last the vacation, but for longer, or more DX-intensive trips, that's clearly impossible. Alkaline batteries are imported and expensive in most of Latin America, so I use AC for the Sony whenever possible. There is an easy way to check the voltage of an outlet. If your room has a lamp, check the voltage of the bulb. If it says 220 & you plug it in to 110, it will be very dim. If you plug a 110 bulb into 220, it will light up very brightly for a fraction of a second. If there's no lamp in your room, borrow one from the hallway. Do not rely on the voltage of a ceiling light; sometimes they are on separate circuits. *—Don Moore*

WORLDWIDE PLUG/SOCKET STANDARDS: It always seems tough to get accurate information about the voltages and plug patterns before travelling abroad, much less locating the proper adapters. A comprehensive guide appears in a catalog published by Panel Components Corporation, P.O. Box 6626, Santa Rosa, CA 95406. The guide is reprinted at the end of this article. Panel Components has a toll-free order line, 1-800-662-2290. *—Gordon Darling*

ANTENNAS

HOOKUP WIRE: I use 50-75 feet of hookup wire for an antenna. Insulated antenna wire is a must, and the way Theresa and I travel, it does double duty. Self-service laundromats are unheard of in most of Latin America, but most cheap hotels have facilities for doing laundry by hand. However, few have adequate clothesline space for all their guests, so our drying-clothes get draped over my antenna wire, which is strung across our room. Tile and cement floors are a definite advantage here.

At least for the cheap places we stay at, the hotel's location usually doesn't have much effect on reception. I had surprisingly good reception in downtown Quito, Lima, and Asuncion. However, the room's location in the hotel can make a difference. Basically, the higher the room, the better. Also, it should have a window. Many cheap hotels have windowless inner rooms, which are considered safer and therefore more frequently given to foreigners.

Besides asking for a room on the top floor, a good trick to improve signal strength and get away from manmade QRN is to DX from the hotel roof. In cheap hotels, it's easy to get to - usually that's where the clotheslines are. It's just a matter of stringing up the antenna wire, and, of course, bringing along a flashlight. An alligator clip can be used to attach the wire to a support, or to spouting or metal pipes that might serve as antennas. *—Don Moore*

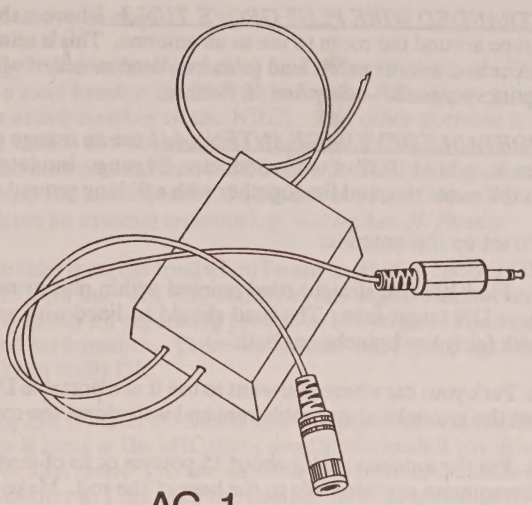
INLINE COMPONENTS AC-1: In early 1989, I heard a rumor about a new indoor active antenna at the unbelievable price of $30. Rich Arland, who is well known for his equipment reviews, swore by the AC-1 from Inline Components. Besides the price, he was impressed by the extremely broad-band performance of the AC-1. It is a reasonably good MW antenna and yet gives FM signals a real boost, too. On short wave, it is often the winner when I compare it to a 60' random wire antenna!

The AC-1 consists of a very small amplifier housing (a 2" x 2.7" x .75" plastic box) and the antenna element itself—a meter of multi-stranded wire. The wire has a hanging loop at the end. The basic idea is to attach the antenna element to an outside window with a suction cup (supplied) after determining the best location. Opposite the antenna element, two other meter-or-so long cables emerge from the case. One of these is the power cable. It may be attached to a 9v plug-in power module or you may use a 9v battery with an attached 1/8" male jack. Guy Atkins went the 9v battery route and attached a

standard battery clip to the back of the main case. Guy also installed an AC-1 module internally in his 2010. (See the 2010/2001D article elsewhere in Proceedings 1990).

One word of caution: it may be possible to "blow the very fragile front end" of the ICF-2010 with the AC-1 or any other antenna plugged in to the ports on the left-hand side of that otherwise fine receiver. You should protect the fragile FET as discussed in the 2010/2001D article before using ANY antenna with that receiver.

I heartily recommend the ICI active antenna, Model AC-1. It is small enough to be rolled up and put in your pocket while travelling and can have you listening/DXing within seconds of walking into the hotel room.



AC-1
Active Antenna

Inline Components, Inc. 4521 Campus Drive, #113, Irvine, CA 92715. —*John Bryant*

WINDOW AND BALCONY ANTENNAS: DX'ing through the concrete and steel walls of most modern hotels is a challenge. I have observed a dramatic difference in reception in hotel rooms when comparing the whip antenna and a 20' length of random wire. Reception improves again when I add a properly tuned active antenna/preamplifier to the 20' wire.

I use the insulated hank of wire that Sony packs with the ICF-2001D, feeding an MFJ-1020 active antenna/preamplifer. This wire seems to resist knotting and tangling; it's 18 gauge stranded copper wire covered with plastic insulation.

Placement of the wire is critical. If you can't open your hotel window, the best thing is to run the wire up along the top of the curtain bar, looping around the window. Set up a table near the window and make sure the end of the wire reaches it. If the room has sliding doors to a balcony, run the wire out to the balcony and loop it around the railing, as inconspicuously as possible. Be careful that the sliding doors don't wear through the insulation and ground out your antenna. —*Rowland Archer*

WINDOW STRIPS: Here's a solution I have found to be useful in getting a portable antenna out the hotel window when on vacation with my Sony 2010.

I have used a method as old as radio itself that may not be known to some of the younger DXers. In the 1930's, all radios had to use an outdoor antenna. One of the common methods of bringing wire inside the house was the use of a window strip, available in all radio supply houses. It was a flat, insulated copper strip about ten inches in length and with a copper spring clip attached to each end. The strip was thin and flexible enough so that most windows could be closed over it. The antenna wire is attached to the clip protruding outside and a short lead to the receiver is attached to the inside clip.

I made good use of one of these strips when my wife and I spent a holiday at a motel in Carmel, CA. I found that the motel window opened with a crank and there was a screen over the window on the inside. The screen was removable, so I was able to put the strip in place, crank the window shut and then replace the screen. —*William S. Sparks*

STRANDED WIRE PLUS GROVE TUN-3: I have a short length of insulated, stranded wire which I drape around the room to use as an antenna. This is attached to the radio through a Grove Tun-3 mini tuner and a short patch lead (also insulated stranded wire). I have had no problems with overload or spurious signals. —*Stephen H. Ponder*

PORTABLE BEVERAGE ANTENNA: I use an orange plastic "cord wheel", sold for storing extension cords, to hold 1000' of twin conductor, 24 gauge, insulated speaker wire. The unit is 10 1/2" in diameter at the outer rim, and fits together with a 2' long ground rod in my folding carry-on suit bag.

To set up this antenna:

1. Find 1000' of straight road pointed within plus or minus 20 degrees of the Great Circle Route to your DX target area. The road should be lined with weeds ranging from knee to waist high or trees with fairly low branches or both.

2. Park your car where you want to use it as a portable DX shack. Attach the antenna firmly to the car, get the ground rod and cable reel and walk down the road until the antenna is fully unwound.

3. Put the antenna under about 15 pounds or so of tension. Put the ground rod in the ground and tie the antenna mechanically to the base of the rod. Make the electrical connection to the rod through a 560 ohm resistor.

4. You now have the Beverage on the ground, under a moderate amount of tension, stretched between the car and the ground rod. Walk back to the car picking the wire up and tossing it on top of the road-side bushes. It's best if the wire doesn't touch the ground, but mine often does in a couple of places. That's another reason for using insulated wire.

5. When you get back to the car, clip your antenna lead on to the near end of the beverage and DX away.

This antenna's characteristic impedance will be in the range of 500 to 600 ohms. If you use coax as a lead-in, or if your receiver has only a 50 ohm antenna input, you should fabricate an impedance matching transformer. These are covered in the Proceedings 1988 article by Hall-Patch and Bryant. You are cautioned that running a 500-600 ohm Beverage into 50 ohm impedance causes signal loss of about 10 DB.

I know this system sounds too easy, but it works magnificently. It receives DX signals at least as well as my much more sophisticated, permanent Beverages. —*John Bryant*

RECEIVERS AND ACCESSORIES

SONY ICF-7600D: My favorite travel receiver is the Sony ICF-7600D (a.k.a. 2002, 2003). The 2010 is much too big for constantly hopping from bus to bus with a duffle bag and knapsack. The receiver is supplemented with a small cassette recorder (a digital counter is a must), blank cassettes, and *two* of all needed cables and adapters. Outside of major cities, replacements can be hard to find. Rather than carrying headphones, I take two earphones and a Y-adapter. It's more compact, and allows Theresa and I to both listen to the radio without disturbing others. Some of these small items fit nicely into 35mm film canisters. —*Don Moore*

SONY ICF-2001: My kit is a SONY ICF-2001, a 50 foot spool of 22 ga stranded antenna wire, a Radio Shack Minisette II tape recorder, two earphones, appropriate jack adapters for the headphones, and spare batteries.

Finally, I've just learned that a flashlight, a simple two cell penlight, can be valuable. For example, when turning out the noise-making lights found in hotels worldwide, DX can be tricky. The penlight saves eyestrain when checking the books.

I carry about a dozen 90 minute blank tapes. —*Gerry Bishop*

TOSHIBA RP-F11 AND MAGNAVOX D-1875: I use two small portables for DX'ing on the road. The first, a Toshiba RP-F11, which I purchased at a local hamfest for $30 (including the AC adapter), has been used for medium-wave DX (I'm also an active member of the NRC). The other portable is a Magnavox D-1875 purchased for around $50. Unlike the Toshiba, the Magnavox has an abbreviated LW band (155-265 kHz). Its SW coverage is also more limited than the Toshiba (it does not begin until 5.95 MHz; the Toshiba includes the 60, 75, 90 and 120 meter bands). I have not used the Grove Tun-3 setup with the Magnavox because it does not have an external antenna lug. —*Stephen H. Ponder*

SONY ICF-2001D: (ICF-2010 in the US) I use this rig on the road when I want to go after serious DX but I don't want to have to haul the NRD-515 with me. It's very sensitive, has digital readout and memories, and does a nice job with ECSSB, very handy for separating packed-in DX targets. I find this rig offers an excellent balance between size and performance. There are smaller and lighter rigs that work well for SWL on the road, but the 2001D can really DX.

I always carry a tape recorder so I can record my DX for later ID checks and reception report program details. A portable recorder with an AUX input is ideal, as the MIC input usually overloads if you drive it with the headphone output of your radio. An alternative is to use an attenuating cable, available at Radio Shack. I prefer a recorder with a tape counter so I can note the counter value at probable ID's for later re-checks. Auto-reverse is also nice, along with a locking fast forward control. —*Rowland Archer*

REFERENCE MATERIAL AND LOGGINGS

WRTH FREQUENCY LISTS, DX EDITORS, ENGLISH NEWS: I take along the back-of-the-book WRTH frequency list, at least up through 10MHz. This is either torn out or photocopied. I also photocopy the country sections for the region I'm visiting. Several weeks before leaving, I begin going through recent issues of **Fine Tuning, Numero Uno,** the **NASWA Journal,** etc. and taking notes on anything interesting. Usually the relevant info can be condensed to two or three pages.

I also include the addresses for Glenn Hauser and other DX editors to mail my DX news to. Blank log sheets and note paper complete my DX resources. In addition, I would never go anywhere without a current list of English broadcasts & frequencies. Not only is such a list useful for entertainment listening, but if natural or political disaster strikes, knowing where to find BBC or CBC news quickly could be life-saving. All these items easily fit into a pocket folder. —*Don Moore*

TARGET LIST: For MW DX'ing I carry the **NRC Domestic Log**, which I *try* to keep updated through club bulletins. For SW DX'ing I usually have an older copy of the **WRTH**. I always try to have a separate list of my 'target stations' arranged in frequency order. Many times I have sheets of info photocopied from **DX News, NASWA Journal, Monitoring Times**, and/or **Popular Communications**. I find the 'by-time' Sundstrom listings in the **NASWA Journal** to be of immense help.

I carry a tablet of paper to use as my log while on the road. I use one sheet of paper for each station heard. When I get back home, I write my reception reports and file these log sheets by frequency in my master notebooks. —*Stephen H. Ponder*

IDENTIFICATION AND TARGETS: My reference materials include both current and archival DX information for target setting and tentative identification. It's best to take what you normally use. I pack a copy of **Passport to World Band Radio**, and the **Danish Short Wave Club's Tropical Band Survey**. I supplement these with the last few issues of **fine tuning** and the **DX Spread**, and perhaps some target-region oriented reference material, such as the **fine tuning Indonesian Survey**. Finally, I add my own current station target list. —*Rowland Archer*

VISITING STATIONS

If you're going to do some travelling in Latin America, or anywhere else for that matter, you might as well do a little "door-to-door DXing" and drop in on the local broadcasters. Theresa named it that one day while we were roaming the streets of Chota, Peru in search of Radio Acunta. Usually, though, it's not too difficult to find local radio stations. They are usually downtown, even in the largest cities. If looking for a particular station, a good place to ask for directions is any other radio station you come across. Everybody knows where the competition is located.

Most stations will be quite excited with a foreign visitor. Lack of interest usually indicates an over-worked staff. After introducing myself, I always ask to see the manager. It's not always easy to see the manager, though, especially in the larger more professional city stations. It may be necessary to make an appointment and come back. Usually in that situation, I just visit with whomever is available; the secretary, an announcer, or an engineer. Obviously the best time to visit is during office hours, Monday to Friday, but it never hurts to stop by in the evening or on a weekend. Sometimes I've hit it lucky, other times I've been asked to come back the next day. On a few occasions I had an interesting conversation with an otherwise bored DJ.

Language is only a problem if the traveler chooses to make it one. Obviously, the more Spanish (or whatever) one speaks, the easier it will be, but throughout Latin America we met numerous travelers who knew no Spanish. They got along fine carrying just a smile and a phrase book. Latin Americans are very patient and understanding with people who make an honest attempt to use Spanish and are willing to laugh at their own mistakes. I've seen these smile-and-a-phrase-book people have real conversations in restaurants, parks, and markets, and there doesn't seem to be any reason it can't happen in a radio station as well. *—Don Moore*

TRAVELLING QSLING

What about QSLs? Many of the same rules for sending reports apply to personal visits: be polite and chatty, but specific in what you want. Shortwave stations will usually have some idea of what a QSL is, but if you pick up a local MW or FM station in your hotel and decide to stop by and get an unusual veri, remember they may have never seen a reception report before. But then you may end up with the only QSL in existence for that station! A few copies of the National Radio Club's 'Broadcaster's Guide to DXing' pamphlet (available in English, Spanish & French) can be quite useful.

Be sure to ask for any pennants or stickers. Remember, however, that even if there is one on the wall, they may have none left to give away. They might give you that last one, if you make a good impression — it happened to me on several occasions. If there is a quantity of pennants or stickers, it doesn't hurt to ask for "two or three more for my friends". You won't be turned down, and probably will be given many more. However, asking for a large quantity, like a dozen, may make you look very greedy and sour the station towards DXers.

While in Honduras, I verified a number of local stations for DXers, and well in advance of my South American trip, I got in touch with some other DXers who valued Latin American QSLs and offered my services. It's not that difficult to solicit a few extra QSLs for DX friends, and I hope anyone planning to visit stations will take along reports for more than themselves.

Remember, however, that if you have only one or two reports, it is not unreasonable to ask the station to type up a veri letter or two. However, with three or more, that can be quite a chore. The best thing to do is either bring some prepared card QSLs along with the reports, or buy some attractive local postcards & write the veri information on the back. Using postcards impresses the stations more. Theresa wrote most of the postcard veri-statements for me in South America, and I suspect she holds the world's record in having one's handwriting on QSLs from the most different stations! Whether with plain ppcs or postcards, the station manager just has to sign and rubber stamp the cards. Of course as the person bringing the reports, you can ask for a special letter verification to commemorate your visit!

If you're planning to do some station visits, be sure to bring along some little gifts. These can include the usual enclosures of postcards, shack or family photos, and hometown travel brochures. It's also a good time to bring along things that aren't as easily sent, such as records & tapes, sports pennants, local picture books, and calenders. The Norman Rockwell type calenders given out by insurance companies and banks make especially nice free gifts, even if the year is already half gone. The pictures will probably end up on the station wall or in somebody's home.

I encourage all hobbyists to do a little "door-to-door DXing". It's a great way to get a first hand view of what the other end of the hobby looks like. Also, while travelling it is very difficult to meet and interact with the "common people" in other countries. The common interest in radio seems to bridge a gap, and on occasion even opens up peoples hearts and homes. *—Don Moore*

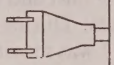
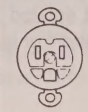
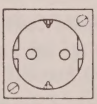
BATTLEFIELD DXING

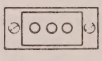
Those of us who like to take our radio camping or in the field with the armed services need additional protection for our rigs when they are not in use. When I bought a Sony ICF-4920 to take with me in the field, I realized that it needed protection. Tupperware was the answer. A small Tupperware container not much larger than the radio itself protected my radio from dust and wetness, even at times when I was either dusty or wet or both. It even works in extreme cases. During a field exercise, I was driving a vehicle at night. Lightning wrecked my night vision and as I was moving into a position, the jeep I was driving fell into a sinkhole. I climbed out to see how bad I was stuck. My radio, which had been next to me behind the mount for the radio, bounced out of the vehicle as it settled into the sinkhole. Guess what? It floated and I waded out and retrieved my radio still safe and dry in its little Tupperware boat. *—Hans Johnson*

Guide to Worldwide Plug/Socket Standards
Single-phase Voltages and Frequencies

See pages 163-164 for listing of countries; refer to the illustrations below to determine plug/socket standard. The information provided for developing countries, particularly that related to plug/socket patterns, is imprecise at best.* For example, as many as five different plug patterns are listed for some countries. The reason is that formal electrical standards, where they exist at all, do not cover plugs and sockets or they are ignored in the marketplace. Furthermore, with regard to voltages and frequencies, power generating and distribution systems have been installed at various times by different contractors. These systems occasionally produce power at different frequencies and provide for final distribution at different voltages. Therefore, some cities—even individual buildings in those cities—may be supplied by two or more generating plants and power distribution systems, each with a different single-phase voltage and frequency. The voltages, frequencies and plug/socket patterns listed here are the most common ones for each country. Most third world electrical distribution systems are ungrounded, hence three contact grounded plugs, while mateable with the sockets, are not necessarily providing the expected equipment ground. Alternative methods of equipment ground may be a desirable feature in these cases.

The data given for single phase voltages are nominal and are subject to a standard tolerance of 10%, but in some areas, particularly in developing countries, tolerances may be much greater. Although standard frequency tolerances are defined differently, variations from the nominal frequencies as listed may be considerably greater in developing countries than in the industrialized world.

Plug Type	Socket Pattern	Plug Pattern	Refer to Catalog Pages
Type A			**North American Ungrounded**
Type B			**North American NEMA 5-15** Plugs & Sockets, see pages 99-114 Cords & Cordsets, see pages 43-48
Type C			**Ungrounded Eurocord (CEE 7/16)** Cord, see page 30
Type D			**Old British Standard BS 546** Plugs & Sockets, see page 106 Cordset, see page 37
Type E			**Belgian/FrenchSocket/ CEE 7/7 plug** Socket, see page 105 Cords & Cordsets, see pages 25-29
Type F			**"Schuko" European CEE 7** Plugs & Sockets, see page 102 Cords & Cordsets, see pages 25-29
Type G			**British Standard BS 1363** Plugs & Sockets, see page 104 Cords & Cordsets, see pages 33-34

Plug Type	Socket Pattern	Plug Pattern	Refer to Catalog Pages
Type H			**Ungrounded Australian**
Type I			**Australian** Plugs & Sockets, see page 103 Cords & Cordsets, see pages 31-32
Type J			**Israeli** Plugs & Sockets, see page 106 Cords & Cordsets, see page 38
Type K			**Danish** Plugs & Sockets, see page 105 Cords & Cordsets, see page 35
Type L			**Swiss** Plugs & Sockets, see page 108 Cords & Cordsets, see page 40
Type M			**Italian 10-amp** Plugs & Sockets, see page 107 Cords & Cordsets, see page 39

* The data presented here was compiled from several sources, including the following:
British Bank of the Middle East, Business Profile Series (Bahrain, 1983; Djibouti, 1981; Jordan, 1983; Qatar, 1982; Saudi Arabia, 1982; Sultanate of Oman, 1982; United Arab Emirates, 1982; Yeman Arab Republic, 1980)
"Electric Current Abroad," 1984 edition, U.S. Dept. of Commerce
"Electrical Plugs—An International Survey," Technical Help to Exporters, British Standards Institution, 1980
"World Electricity Supplies," Technical Help to Exporters, 1975; Supplement, 1978

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Guide to Worldwide Plug/Socket Standards
Single-phase Voltages and Frequencies (Cont'd.)

Country Name	Single Phase Voltage	Frequency (Hz)	Plug Pattern (see p. 162)
AFGHANISTAN	220	50	D
ALGERIA	127/220	50	C, D
AMERICAN SAMOA	120/240	60	A, B, F, I
ANGOLA	220	50	C
ANGUILLA (GB)	240	50	G
ANTIGUA	230	60	A, B, G
ARGENTINA	220	50	C, I
ARUBA	115/127	60	A, B, C, D, F
AUSTRALIA	240	50	I
AUSTRIA	220	50	F
AZORES (PORTUGAL)	220	50	C, D
BAHAMAS	120	60	A, B
BAHRAIN	220	50	D, G
BANGLADESH	220	50	C, D
BARBADOS	115	50	A, B
BELGIUM	220	50	C, E
BELIZE	110	60	A, B
BENIN	220	50	D
BERMUDA	120	60	A, B, G, I
BOLIVIA	110-115/220	50	A, B, C, F
BOTSWANA	220	50	D, G
BRAZIL	110-220	60	A, B, C
BULGARIA	220	50	C, F
BURKINA FASO	220	50	C
BURMA	230	50	D, G
BURUNDI	220	50	C, E, F
CAMBODIA	120/220	50	C
CAMEROON	220-230	50	C, E
CANADA	120	60	A, B
CANARY ISLANDS (SPAIN)	220	50	C, E
CAPE VERDE, REP. OF	220	50	C, F
CAYMAN ISLANDS	120	60	A, B
CENTRAL AFRICAN REP.	220	50	C
CHAD	220	50	D, E, F
CHANNEL ISLANDS	240	50	C, G
CHILE	220	50	C, M
CHINA, People's Rep. of	220	50	C, I
CHRISTMAS IS. (AUST.)	240	50	I
COCOS ISLANDS (AUST.)	240	50	I
COLOMBIA	110-220	60	A, C
CONGO, REP. OF	220	50	C,
COOK ISLANDS (N.Z.)	240	50	I
COSTA RICA	120	60	A, B
CYPRUS	240	50	G
CZECHOSLAVAKIA	220	50	F
DENMARK	220	50	C, K
DJIBOUTI, REP. OF	220	50	C, E
DOMINICA	230	50	G
DOMINICAN REP.	110	60	A, B
EGYPT	220	50	C
EL SALVADOR	115	60	A, B
EQUADOR	120	60	A, C
EQUATORIAL GUINEA	220	50	C
ETHIOPIA	220	50	C, D, F
FIJI	240	50	I
FINLAND	220	50	C, F
FRANCE	220	50	C, E
FRENCH GUIANA	220	50	C, E
GABON	220	50	C, E
GAMBIA, THE	220	50	G
GERMAN DEM. REP.	220	50	C, F
GERMANY, FED. REP. OF	220	50	F
GHANA	220	50	C, D, G
GIBRALTAR	240	50	C, G
GREECE	220	50	C, F
GREENLAND (DEN.)	220	50	C, K
GRENADA	230	50	C, D, G
GUADELOPE	220	50	C, E
GUAM	110-120	60	A, B
GUATEMALA	120	60	A, B
GUINEA	220	50	C, E
GUINEA-BISSAU	220	50	C, F
GUYANA	110	50-60	A, B, C, D, G
HAITI	110-120	50-60	A, B
HONDURAS	110	60	A, B
HONG KONG	200	50	D, G
HUNGARY	220	50	F
ICELAND	220	50	C, F
INDIA	220-250	50	C, D
INDONESIA	220	50	C, F
IRAN	220	50	C, F
IRAQ	220	50	C, D, G
IRELAND	220	50	F, G
ISLE OF MAN	240	50	C, G
ISRAEL	230	50	J
ITALY	220	50	C, M
IVORY COAST	220	50	C
JAMAICA	110	50	A, B
JAPAN	100	50 & 60	A, B
JORDAN	220	50	C, F, G
KENYA	240	50	D, G
KOREA	100/220	60	A, F
KUWAIT	240	50	C, D, G
LAOS	220	50	A, C
LEBANON	110-220	50	C
LESOTHO	240	50	C, D
LIBERIA	120	60	A, G
LIBYA	127-230	50	D
LIECHTENSTEIN	220	50	L
LUXEMBOURG	220	50	C, F
MACAO	220	50	C, D
MADAGASCAR	220	50	C, E
MADEIRA (PORTUGAL)	220	50	C, D
MAJORCA	220	50	C, F
MALAWI	230	50	G
MALAYSIA	240	50	G
MALDIVES	230	50	D
MALI, REP. OF	220	50	C, E
MALTA	240	50	G
MARTINIQUE	220	50	C, E

Guide to Worldwide Plug/Socket Standards
Single-phase Voltages and Frequencies (Cont'd.)

Country Name	Single Phase Voltage	Frequency (Hz)	Plug Pattern (see p. 162)
MAURITANIA	220	50	C
MAURITIUS	230	50	C, D, G
MEXICO	127	60	A
MONACO	220	50	C, E
MONGOLIA	220	50	C
MONTSERAT	230	60	A, B, G
MOZAMBIQUE	220	50	C, F
MOROCCO	220	50	C, D, E, F
NAMIBIA	220-250	50	D
NEPAL	220	50	D
NETHERLANDS	220	50	C, F
NETHER. ANTILLES	120-127/220	50/60	A, B, C, F
NEW CALEDONIA	220	50	C, E
NEW ZEALAND	230	50	I
NICARAGUA	120	60	A
NIGER	220	50	C
NIGERIA	230	50	D, G
NORFOLK IS. (AUST.)	240	50	I
NO. MARIANA IS. (US)	115	60	A, B
NORWAY	220	50	C, F
OKINAWA	100-120	60	A
OMAN	240	50	D, G
PAKISTAN	230	50	C, D
PANAMA	110-120	60	A, B
PAPUA	240	50	H, I
PARAGUAY	220	50	C
PERU	110/220	50/60	A
PHILIPPINES	115	60	A, B, C
PITCAIRN ISLANDS(GB)	240	50	G
POLAND	220	50	C, F
PORTUGAL	220	50	C, D, F
PUERTO RICO	120	60	A, B
QATAR	240	50	D, G
ROMANIA	220	50	C, F
RWANDA	220	50	C
SAUDI ARABIA	127/220	50/60	A, B, E, F
SENEGAL	220	50	E
SEYCHELLES	240	50	D, G
SIERRA LEONE	230	50	D, G
SINGAPORE	230	50	C, D, G
SOMALIA	110/220	50	C, E

Country Name	Single Phase Voltage	Frequency (Hz)	Plug Pattern (see p. 162)
SOUTH AFRICA	220-250	50	D
SPAIN	220	50	C, F
SRI LANKA	230	50	D
ST. PIERRE & MIQUELON (FR.)	115	60	A, B
ST. KITTS AND NEVIS	230	60	D, G
ST. LUCIA	240	50	G
ST. VINCENT	230	50	G
SUDAN	240	50	C, F, G
SURINAM	115	60	C, F
SVALBARD (NORWAY)	220	50	F
SWAZILAND	230	50	D
SWEDEN	220	50	C, F
SWITZERLAND	220	50	C, L
SYRIA	220	50	C
TAHITI	220	50	E
TAIWAN	110	60	A, B
TANZANIA	230	50	D, G
THAILAND	220	50	A, C
TOGO	220	50	C, E
TONGA	115	60	D, I
TRINIDAD & TOBAGO	115/230	60	A, B, D, G
TUNISIA	220	50	C
TURKEY	220	50	C, F
UGANDA	240	50	G
UNITED ARAB EMIR.	220	50	D, G
UNITED KINGDOM	240	60	D, G
UNITED STATES	120	60	B
URUGUAY	220	50	C, I
U.S.S.R.	220	50	C, F
VENEZUELA	120	60	A, B
VIETNAM	120/220	50	A, B, C, E
VIRGIN ISLANDS	120	60	A, B
WESTERN SAMOA	230	50	NO INFORMATION
YEMEN (ADEN)	220	50	D, G
YEMEN (ARAB REP.)	220	50	C, D
YUGOSLAVIA	220	50	C, F
ZAIRE, REP. OF	220	50	E
ZAMBIA	220	50	G
ZIMBABWE	220	50	D, G

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AN INTRODUCTION TO DXPEDITIONS

A Compendium

Nick Hall-Patch

Setting up a listening post away from normal sources of interference to concentrate on DXing is known as a DXpeditions. One can go to a rural site where there is room to set up Beverages or rhombics, or compare and try new equipment and accessories, or share experiences and expertise on the spot with other DXers. A good DXpedition is not just a lot of sitting around listening to the radio. We've all experienced the thrill of hearing one of those "tough catches;" at a DXpedition, all can share the experience. When one DXer hears "This is Tristan radio," you can be sure that there will be some sort of verbal expression that will alert the others present that something significant is afoot. You can't help but share.

As you enjoy the advantage of a low-noise area and better antennas, you will likely put more into DXing on a DXpedition. DXers occasionally listen all night; a DXpedition could be a weekend of all-nighters in good DX surroundings with more ears nearby. (M.A.R.E. DXpedition Guide [1])

The primary aim of DXpeditions is DXing, but while DXing is traditionally a solitary activity, DXpeditions are usually a social activity as well. ODXA's "DX camps" at Longford Mills can be quite a large social event, and are more like a DX club convention held at a site suitable for DXing.

The more common DXpedition involves two to five people and may run for a long weekend, with some DXers dropping by for a night or two. In northern Europe, DXpeditions can stretch over a couple of weeks with "shifts" of DXers attending. It's pleasant if such expeditions can take place in a heated building, but they have been quite successful using campers, vans, and the occasional car or tent, not to mention the University of Manitoba DX Club's "DX bus."

Overnight DXpeditions often involve hopping into one's car with the necessary equipment and going to a good site within an hour or two's drive, tossing an antenna into the trees, hooking up the receiver to the car's 12 volt supply, and DXing for a few hours before returning home. These trips can be a good way for a DXer to check out a new site before inviting the crowd along.

Even if you're lucky enough to have a permanent location for your DXpeditions, the one thing which will guarantee success other than great conditions, is PLANNING; it's the best way to keep Murphy at bay. You will want to plan when and where to go, who to go with, what to bring, who will bring what, how to set things up, and what to listen for. DXpeditions are a kind of camping trip, so if you're a well-organized camper or traveller, planning for a DXpedition shouldn't to too onerous. Niel Wolfish offers this DXpedition equation:

"less work = more time to DX"

By planning ahead, you can make much less work for yourself, and still have some time and energy left over for DXing.

Nick Hall-Patch is shown in the photo on the left, posing with an early version of his home brew solid state DX receiver. Besides being Technical Editor of IRCA's DX Monitor, Nick is one of the more veteran DXpeditioners in the listening hobbies.

WHERE TO GO

--someplace electrically quiet, which usually implies a place far from power lines and local transmitters, that is, from populated areas. This is the single most important point. A simple antenna and an inexpensive receiver can perform wonders in a quiet location.

--someplace with enough space and trees available to support the various antenna structures. Beverage antennas are easily erected and work very well, but should be at least 1000' long and aimed towards the area you want to hear. Is there enough room for two or three Beverages aimed at prime DX areas?

--the location should have a relatively clear horizon in the desired direction, as large hills and mountains may shadow you from the low angle DX signals you are after. Of course you may also use this shielding to reduce signals from local stations.

--be sure you are allowed to use a location, so you won't run afoul of the law. Camping or even overnight parking may not be permitted in some areas.[3]

* * * * *

The first step is to check with friends for facilities they may already have available such as a weekend cabin or a home in the country. They may be willing to lend you a building or a camp site on their property. (John Bryant suggests you emphasize medium wave listening in this situation. Some people equate shortwave with "hot" and unsightly amateur radio antennas, but are tickled at the idea of you hearing Australian BCB on their property.

Check out public facilities such as parks and campgrounds. Some are equipped with cabins or similar shelters, but also come with lots of rules and regulations. Find out what they are, understand them, and let the authorities know exactly what you are going to be doing. There may be limitations on antennas. M.A.R.E. DXpeditions have been held in an ideal structure in a State Park, an insulated cabin with a wood stove and bunk beds.

Those who are willing to DX in tents or vans have more options than those who need more shelter, but consider the variation in weather likely to be encountered. Tent DXing in the snow can be done, but gives you at least two or three more worries.When a potential site is found, explore it on foot. Check each direction for obstacles to erecting antennas. Locating obstacles on a map and noting compass directions can be helpful before putting up antennas.

A.C. power at a site is a mixed blessing. It can make life simpler by supplying light, heat, receiver power, etc., but can also supply interference. See whether any A.C. power can be shut off, at least for some periods.[1]

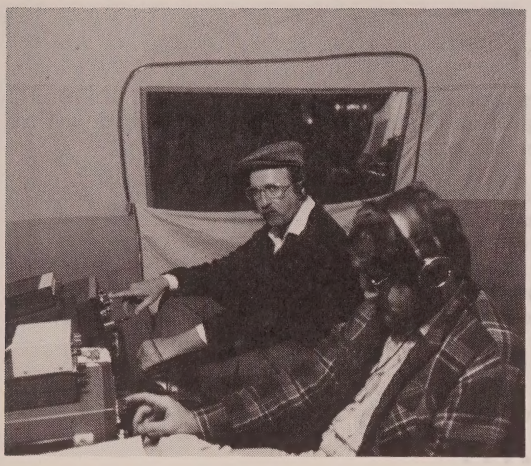
* * * * *

Choosing an antenna site which favors best reception of DX signals still seems to be an infant art. Obviously a site by the ocean will provide DX from the other side of that ocean, but why have sites in the eastern foothills of the Rocky Mountains provided good MW DX from Australia?

Perhaps in the future there will be communication between listening sites using amateur radio which will help determine which sites have more DX potential than others. There is a lot of research waiting to be done in this field.

* * * * *

Finally, consider a site from a camper's point of view. Will a cold, damp location, or hordes of mosquitoes assist you in logging that rare one?



Some of our southern contingent at the beginning of a 1990 Shortwave Week DXpedition to Mississippi. The left-hand photo catches the dapper **Jerry Lineback** in the background and **Kevin Atkins** in the hair. The right photo is **John Tow** on the same DXpedition. **Kevin** and **Jerry** wouldn't let **John** in the tent 'cause he brought along a scanner!

WHEN TO GO

Don Moman suggests that your listening plans and targets should be planned according to which DX paths are likely to be open, although there is usually DX possible on some band at any given time; you've just got to find the band. Obviously it's an advantage if you're an all band DXer. Solar indices (via WWV at 18 past and WWVH at 45 past the hour) should be monitored before and during the expedition, as solar flares and storms can produce enhanced reception of certain paths. Depending on your location, certain areas may be more likely to be heard at certain times of year, but summer static levels may make listening unbearable on the lower frequencies.

Don't always assume that traditional wisdom is correct concerning DX possibilities. DX has been received on the "wrong" direction Beverage antenna, and at unexpected times and under unusual ionospheric conditions. However you may want to call a DXpedition off under certain ionospheric conditions, especially if you're concentrating on one band or area of the world. Weather conditions can also put a damper of a DXpedition, especially if you will be camping in primitive conditions. Be sure to get to a site in plenty of time to set up the desired antennas and other equipment, as these activities can become tedious in the dark. Also, there is no point in being too exhausted to DX after rushing a 2 hour site set up in half an hour!

WHAT TO LISTEN FOR

Random tuning may bring in a good catch or two, particularly if one is not an experienced listener. And bandscans can give one a feel for what is getting through the ionosphere. "A little preparation before the DXpedition can make your listening more fruitful, especially if you are going for new stations, countries or QSLs. Make up a "hit list" of the stations you want to try for. Go ahead, don't be shy, put down the Bhutan English Service; do you have anything better to do at 0830? Make a list out by time, like a broadcast schedule. That way, you can plan your listening from hour to hour, as well as your sleep schedule. If there are several people present, there will usually be someone in action most of the time. Leave a wake-up callif you plan to sleep.

Be prepared to adjust your schedule depending on DX conditions and openings. If the medium-wave TA's are booming in, you may want to sacrifice those African SW's you were after or vice-versa. You can try for those you missed the next night."[1]

WHERE TO GO

--someplace electrically quiet, which usually implies a place far from power lines and local transmitters, that is, from populated areas. This is the single most important point. A simple antenna and an inexpensive receiver can perform wonders in a quiet location.

--someplace with enough space and trees available to support the various antenna structures. Beverage antennas are easily erected and work very well, but should be at least 1000' long and aimed towards the area you want to hear. Is there enough room for two or three Beverages aimed at prime DX areas?

--the location should have a relatively clear horizon in the desired direction, as large hills and mountains may shadow you from the low angle DX signals you are after. Of course you may also use this shielding to reduce signals from local stations.

--be sure you are allowed to use a location, so you won't run afoul of the law. Camping or even overnight parking may not be permitted in some areas.[3]

* * * * *

The first step is to check with friends for facilities they may already have available such as a weekend cabin or a home in the country. They may be willing to lend you a building or a camp site on their property. (John Bryant suggests you emphasize medium wave listening in this situation. Some people equate shortwave with "hot" and unsightly amateur radio antennas, but are tickled at the idea of you hearing Australian BCB on their property.

Check out public facilities such as parks and campgrounds. Some are equipped with cabins or similar shelters, but also come with lots of rules and regulations. Find out what they are, understand them, and let the authorities know exactly what you are going to be doing. There may be limitations on antennas. M.A.R.E. DXpeditions have been held in an ideal structure in a State Park, an insulated cabin with a wood stove and bunk beds.

Those who are willing to DX in tents or vans have more options than those who need more shelter, but consider the variation in weather likely to be encountered. Tent DXing in the snow can be done, but gives you at least two or three more worries.When a potential site is found, explore it on foot. Check each direction for obstacles to erecting antennas. Locating obstacles on a map and noting compass directions can be helpful before putting up antennas.

A.C. power at a site is a mixed blessing. It can make life simpler by supplying light, heat, receiver power, etc., but can also supply interference. See whether any A.C. power can be shut off, at least for some periods.[1]

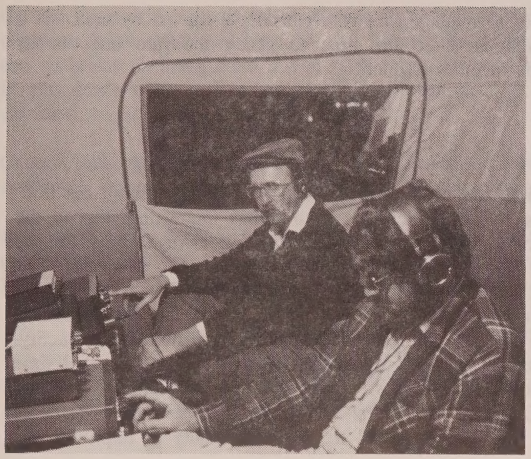
* * * * *

Choosing an antenna site which favors best reception of DX signals still seems to be an infant art. Obviously a site by the ocean will provide DX from the other side of that ocean, but why have sites in the eastern foothills of the Rocky Mountains provided good MW DX from Australia?

Perhaps in the future there will be communication between listening sites using amateur radio which will help determine which sites have more DX potential than others. There is a lot of research waiting to be done in this field.

* * * * *

Finally, consider a site from a camper's point of view. Will a cold, damp location, or hordes of mosquitoes assist you in logging that rare one?



Some of our southern contingent at the beginning of a 1990 Shortwave Week DXpedition to Mississippi. The left-hand photo catches the dapper **Jerry Lineback** in the background and **Kevin Atkins** in the hair. The right photo is **John Tow** on the same DXpedition. **Kevin** and **Jerry** wouldn't let **John** in the tent 'cause he brought along a scanner!

WHEN TO GO

Don Moman suggests that your listening plans and targets should be planned according to which DX paths are likely to be open, although there is usually DX possible on some band at any given time; you've just got to find the band. Obviously it's an advantage if you're an all band DXer. Solar indices (via WWV at 18 past and WWVH at 45 past the hour) should be monitored before and during the expedition, as solar flares and storms can produce enhanced reception of certain paths. Depending on your location, certain areas may be more likely to be heard at certain times of year, but summer static levels may make listening unbearable on the lower frequencies.

Don't always assume that traditional wisdom is correct concerning DX possibilities. DX has been received on the "wrong" direction Beverage antenna, and at unexpected times and under unusual ionospheric conditions. However you may want to call a DXpedition off under certain ionospheric conditions, especially if you're concentrating on one band or area of the world. Weather conditions can also put a damper of a DXpedition, especially if you will be camping in primitive conditions. Be sure to get to a site in plenty of time to set up the desired antennas and other equipment, as these activities can become tedious in the dark. Also, there is no point in being too exhausted to DX after rushing a 2 hour site set up in half an hour!

WHAT TO LISTEN FOR

Random tuning may bring in a good catch or two, particularly if one is not an experienced listener. And bandscans can give one a feel for what is getting through the ionosphere. "A little preparation before the DXpedition can make your listening more fruitful, especially if you are going for new stations, countries or QSLs. Make up a "hit list" of the stations you want to try for. Go ahead, don't be shy, put down the Bhutan English Service; do you have anything better to do at 0830? Make a list out by time, like a broadcast schedule. That way, you can plan your listening from hour to hour, as well as your sleep schedule. If there are several people present, there will usually be someone in action most of the time. Leave a wake-up callif you plan to sleep.

Be prepared to adjust your schedule depending on DX conditions and openings. If the medium-wave TA's are booming in, you may want to sacrifice those African SW's you were after or vice-versa. You can try for those you missed the next night."[1]

A time-organized hit list makes listening a bit easier to manage, but also consider a hit list by area. If a regular station is in at unprecedented strength, that may be the time to check the rare ones in its neighborhood, and to find out if the opening extends to other frequencies.

WHO TO GO WITH

Other DXers, naturally. As with any social occasion, it's best to have compatible people along, but don't let this advice turn DXpeditions into closed events. New participants keep things interesting, and in the unlikely event that someone wants to turn the occasion into a beer bash, you will always know for the next time.

Be aware that the more DXers there are, the more complicated the planning for the trip becomes. Usually, two or three DXers is a reasonable trade-off between good fellowship and planning complexity. Even with a small number, it is useful to visualize the shared receiver and antenna set-ups ahead of time so that the right number and kind of antenna and power cables, connectors and adaptors are brought along. For example, antenna splitters using BNC jacks, are not much use for another DXer who uses UHF-type connectors exclusively. Murphy's Law will prevail at all times, so be ready to improvise, no matter how well prepared you are.

ORGANIZING A DXPEDITION

Each DXpedition should have an organizer, or at least a focal point for communications and questions. All participants should have the following information:

1. A detailed map or directions to a location.
2. Specific dates and check-in and check-out times if appropriate.
3. Any special rules at the site (e.g. no alcohol, no fires)
4. Utilities and facilities available and not available.
5. Checklist of items to bring.
6. List of specific persons to bring certain items.

A sheet with all the pertinent information for all participants is recommended. Be sure to include the organizer's name, address and phone number so that contacts can be made.

The map details and directions required will depend mainly on how isolated the site is. Include a copy of the appropriate section of a road map, but also include a sketch of the access from main roads. Note distances and check points, such as "Turn right off Whistle Britches Road at the Murray for Mayor sign; go 2.5 miles east to the abandoned car; we are in the old barn on the left." Folks not sure where they are going should check out the site ahead of time, or make sure they can ride with or follow someone else. Finding the place at night may not be a simple task.

Special rules such as check out times usually apply at public facilities such as parks and even on undeveloped public property. The same sort of rules may apply on private property. Let everyone know what the rules are; following them will help your chances of using the site again. Good DXpedition sites are hard to find.

The utilities available at the site should be known, so that each participant can plan accordingly. Is there water or power on the site? What are the toilet facilities? Participants must know what to expect ahead of time.

The organizer needs to know how many will be present to plan space available, and to arrange for shared items to be brought. The number of people involved should be determined by the space available. Space to sleep, space to set up receivers, and space to put up antennas are the key factors. It will be necessary to plan antennas collectively, as there will be quite a wire jumble if each DXer puts up three or four antennas to his targets. About 20 square feet per DXer will allow room for receivers, reference books, logbooks, coffee cups and elbow room.

Certain items will be used by all participants, such as camp lanterns, camp stove, first aid kit etc. Let the organizer know what you have, so that he can assure that someone brings them. Backups for these items can be handy so bring them if you have room. If you don't bring the grill, bring the charcoal and lighter. If you don't bring a lantern, bring a cylinder etc. If you don't bring a receiver, you'll be bored all weekend.

General lighting can be provided by camp lanterns. Two or three may be required, as just one will cast shadows. Bring two cylinders per lantern, or have each person contribute a cylinder to the cause.

A propane camp stove is much easier to use than a charcoal grill as it can be used inside. A one pound propane cylinder will probably last the weekend, but have an extra available. (The long term or frequent DXpeditioner will probably want to use a larger refillable propane tank in order to save money...)

After a few times out, it may be unnecessary to tell the "veterans" what to bring, but it is to be hoped that there will always be some new blood on a DXpedition. Having a packet of basic information can save the organizer and the DXer a lot of time and some unnecessary trips back to town. This will be especially true whenever a new site is found.[1]

WHAT TO BRING

Experienced campers already know that going through a checklist is really helpful before leaving. The DXpeditioner simply adds radio related materials to the camper's checklist. The author once took only 20 minutes between the decision to DXpedition and actually leaving the house with everything needed, but has also once left his reel of Beverage wire sitting on the basement floor. A well-known DXpeditioner (who shall remain anonymous) has left his radio at home, which must have caused his wife to wonder what he was really up to!

Though each person will have his own specialized checklist which will depend on how extensive a trip is anticipated, Figure 1 is a sample list garnered from several sources. Each category is broken down into a "common" category (e.g. each DXer brings a radio) and "extra suggestions" category (not everyone wants to bring several dozen Jolt Cola).

The photo on the right shows RCI's interview of the Canadian International DX Club on one of their more-or-less annual DXpeditions at Pembina Forks, Alberta. The interviewer on the right is **Larry Shewchuk.** The others from the left: **Nigel Pimblett, Nick Hall-Patch** and **Don Moman.**

FIGURE ONE
DXPEDITION CHECK LIST

LISTENING POST

Common

--main receiver
--extra fuses for any fused equipment
--all interconnecting antenna cables, patch cords, adaptors, power cords etc. It helps if these are neatly arranged in one case.
--headphones
--Reference books (WRTH etc.)
--Logbook or forms; pens and pencils
--tape recorder with tapes; don't forget batteries or power cable or patch cords
--clock or wristwatch with alarm

Extra Suggestions

--backup receiver, perhaps with memories for quick checks of DX frequencies, parallels etc.
--any other backups: cables, headphones, etc.
--"DX Edge", sunrise/sunset charts or tables
--hunt lists
--hooks or tie downs for routing cables or other support (see article below)
--list of bearings or azimuthal map
--table and chair if needed

PERSONAL OR CAMPING ITEMS

Common

(some will be unnecessary on short trips)

--food (snacks if short term; main meals if longer term. Secure food if animals are a problem, or use cans)
--drinks (bring plenty of water if none on site). --personal sundries: towels, wash cloths, soap, tooth brush and paste, toilet paper, personal medicines, sunscreen, etc.
--plates and cups; eating utensils
--paper towels, tissue, napkins
--insect repellant
--clothing (bring a variety of light and heavy clothing; rain or snow gear as appropriate. Best to have extra clothes to compensate for being caught in a downpour)
--sleeping bag and pillow
--first aid kit
--light source, fuel, matches or igniter. Even if camp lanterns are to be the main light source, bring some candles and matches
--plastic garbage bags
--can and bottle opener
--camp stove, fuel, matches
--car emergency supplies; tools, jumper cables, water
--sturdy boots
--pots and pans

Extra Suggestions

--cooler with ice or cold packs.
--tent, tarp, ground sheet, pegs etc.
--camera, film, flash
--heat source, fuel, matches
--orange vest or hat to keep hunters at bay

HARDWARE

Common

--screwdriver (multi-head)
--needle nose pliers
--wire cutters
--wire strippers or pocket knife
--extra wire
--duct, packing or other plastic tape
--medium duty work gloves
--good flashlight (it is useful if hardware can all be in one tool kit)

Extra Suggestions

--sandpaper for getting lacquer off magnet wire
--alligator clip leads
--glue
--soldering supplies (see article below)
--shovel; other hand tools for dealing with the bush
--multimeter for basic troubleshooting
--walkie-talkies for communications while stringing antennas

ANTENNA MATERIALS

Common

--antenna wire and lead-ins
--ground rods and wire
--pre-made antennas (dipoles, active, loops etc.) with lead-ins, power supplies, batteries, etc.

Extra Suggestions

--miscellaneous antenna supports, matching transformers, splitters, antenna switches, preselectors, tuners, phasing units or other accessories and all interconnecting and power cables
--compass (for aiming antennas)
--termination resistors for Beverages
--rope or twine for pulling and guying antennas
--hammer or hatchet for ground rods and antenna support stakes
--wire winder for taking in antennas

DXPEDITION HINTS AND KINKS

POWER

AC power may be available, but most us us will be using 12 volts DC for our radios. The automobile cigarette lighter outlet is a favorite DC source, particularly on overnight DXpeditions. However, some of the modern receivers draw reasonable current, and an all night session may kill a weak car battery. One more reason to maintain your car and to have at least two vehicles along on any major expedition.

The DXpeditioner with masses of power hungry equipment would be well advised to invest in an auxiliary rechargeable battery. Marine/RV deep cycle batteries will handle many charge/discharge cycles, unlike an average automobile battery. "Gel-cells" are a rechareable lead-acid battery which will not spill acid, and will take deep discharge cycles but are expensive. Unfortunately, surplus gel-cells are not always in good shape, so buyer beware.

If you have a D.C. voltmeter, check your battery occasionally throughout the DXpedition. A new, fully charged 12 volt battery should put out between 13.0 and 13.8 volts. A battery at about 12.5 volts will likely have a very limited useful life and a battery reading 12.0 volts is essentially used up and must be recharged. You should check the voltage every few hours to gauge the use rate, especially if the battery reads 12.5volts or less at the beginning.

A typical car alternator can charge a normal battery in 1 to 4 hours, depending on the battery rating and the car. Connect your battery directly to the car with jumper cables or connect it via the cigarette lighter. That way, you can make a run into town or tour the country-side while your battery is charging.

If you have never run your receiver and accessories on batteries before, make a trial run before the DXpedition to determine the battery life. For example, type C or D cells will typically last only a few hours, so you will probably need refills. Find out what to expect and bring extras. Alkaline cells last considerably longer than regular cells and are usually worth the extra cost. It may be worthwhile to use an adapter to run smaller radios off a 12 volt rechargeable DC supply, or bring along two sets of charged ni-cad rechargeable cells. Be sure that you include <u>all</u> your accessories in your battery life tests.[1]

120 VOLTS AC ON DXPEDITIONS

The stories of DXpedition dreams hashed under S9+20 electrical noise were so awful that John Bryant never even took a portable radio to a local rental outlet to check out any AC generators. In 1989 however, he purchased a small gasoline powered AC/DC generator, the Coleman PowerMaster model PM-1500, for under $400. The generator had a grounding lug which John felt might indicate that the designers were thinking about RFI suppression. He was right; even without the PM 1500 grounded, no RFI was introduced into the receiver. Now, he often takes the Coleman generator on DXpeditions even though all his gear is DC powered. It is wonderful to have several 100 watt work lights around; you can actually see how haggard all the DXers look at 4 AM.
Why are his results so different from those reported by others? Maybe their generators used cruder technology or maybe the Coleman designers really cared about RFI.

There is some ambient engine noise using this generator, so he usually puts it at the other end of a 50' extension cord. Although it hasn't been used in bad weather yet, it probably should be protected from the elements.

So, before you buy or rent an AC generator, use a portable radio to check out its RFI performance in action. You too may be able to DXpedition using 120 volts AC.

SOME HANDY COMPONENTS FOR DXPEDITIONING

John Bryant suggests:
A) The 2 for 1 Cigarette Lighter Converter (Radio Shack #270-1535 $5.49) This gadget permits use of two 12 volt devices from one cigarette lighter outlet. Also available from Radio Shack is a 3 outlet cigarette lighter receptacle which is mounted in a small box and gets its power from the vehicle cigarette lighter. (RS #270-1544 $10.49)

B) Extra Stout Hook Fastening Material (RS #64-2360). This material comes in pads of approximately 1" x 4" and is made up of the "hook" part of the Velcro fastening system. Two of these pads will mate with an audible "pop" and are extraordinarily strong. John's ICF-2010 has travelled more than 3000 miles mounted to a vertical wall in his trailer with four 1" x 1/2" pieces of this material. The material is now used in many other applications where things are fastened only semi-permanently. Super Stuff!

C) A replacement for "in-line" cylindrical fuses
In-line fuse holders are the dastardly spring-loaded plastic housing which snap apart to reveal a standard cylindrical glass fuse. Even Hulk Hogan would have trouble opening one of these; they are a real irritant when dealing with 12 volt fuse protected circuits. Another type of "fuse" is available apparently only at RV parts houses. It is a 20 (or 30) amp circuit breaker and is a little block of plastic about 1" x 1/2" x 1/2" with two threaded connection studs on one face. The type made by Tekonsha costs about $3.00 each. This is a bi-metal device that opens the circuit if it is heated by overloading; when it cools, it reconnects the circuit automatically. There is no visual cue to tell whether the device was open or closed, but a circuit tester out of a 12 volt bulb and two alligator clips works fine. No more Hulk Hogan impersonations replacing in-line fuses!

SOLDERING AIDS

Unfortunately, there are unfortunately times on a DXpedition when a soldering pencil would come in handy, but you may have been deterred by the outrageous prices of 12 volt DC soldering irons or of the small butane powered soldering torches. Recently, Radio Shack has offered a soldering pencil (#64-2105) at a mere $5.49 complete with a cigarette lighter plug. It heats up quickly and is fine for small jobs.

For larger work, like thick wire to ground rods, haul out your propane blowtorch and fit a soldering head onto it. The head is available as an accessory for the torches, and is often supplied in a complete blowtorch kit. These are only good for larger jobs out in the open, and you have to be very careful of where the flame from the torch is playing while you're soldering.

These two photos were taken at ODXA's justly famous annual club-wide DXpedition at Longford Mills, Ontario. The left photo is a shot of just one corner of the DX "shack." Nearly a hundred receivers! The right photo shows **John Fisher** in the background and **Cedric Marshall** driving Cedric's vintage R-388 hollow state receiver.

THE USES OF BRIGHT COLORS

If you use a lead weight to toss antennas into the tree branches, paint it with a bright color, or tie a piece of bright ribbon to the weight. If you tend to drop wrenches, screwdrivers etc., they're a lot easier to find in the shrubbery along with that lead weight if they're all brightly colored.
If you DXpedition in the woods during hunting season (and even outside the season; not everybody observes the rules) wear a bright vest or cap. These are available as safety items at hardware stores. You haven't lived until you are reeling in a wire on a foggy morning with the sound of rifles in the distance, and your vest is back home... A can of fluorescent orange spray paint is therefore a useful aid to the DXpeditioner, as presumably one could save the cost of a safety vest by spray painting an old jacket along with the tools and the lead weight. --NHP

DXING COMFORT TIPS

"If you are alert, comfortable and well-organized, you will make the best use of your limited DXpedition time."

--Don Moman

No matter what accommodation you use for DXpedition, personal comfort is very important while DXing. That's why many of us prefer a cabin or motor home for our DXpeditions. They provide some stretching room, and they keep us warm and dry. Truck campers or camperized vans can be pleasant places from which to DX, as they have table and chairs and provide sleeping accommodation for one or two people as well.

Heating any of these DX shacks can be a problem, unless they're equipped with a proper heater which is vented to the outside. Unfortunately, by the time you've warmed up a van or tent with a portable kerosene or propane heater, you've created a fuggy, and possibly dangerous, atmosphere which will incline you to sleep rather than to DX. It does seem that the "catalytic" heaters which are fueled by propane or white gas provide good heat without fouling the atmosphere.

Of course, the intrepid winter DXer should be dressed in multiple layers of clothing. He may sit up in a sleeping bag to cut down on heating requirements, but he will still need to keep his hands warm. For vehicle DXing, warm clothing, body heat, plus occasional sessions with the car heater running may be sufficient to keep the listener comfortable on all but the coldest nights. One DXer used a small domed tent for DXing and kept himself warm with his propane lantern and sleeping bag. Now, that's efficient use of heat, as temperatures outside were 10 degrees F.

* * * * *

Each DXer's set-up should allow for space for books and other items in addition to receivers. Antenna lead-ins should be held out of the way with cup hooks or other fasteners. Besides general lighting, a small light source at each DXer's area can help when looking up items in books or making log entries.

A chair with a back and arms is highly recommended, as you will be sitting for long periods, and a bench can quickly become uncomfortable. If you need to bring your own table, make sure that chair and table match for comfortable writing and use of equipment.[1]

* * * * *

The above recommendations are harder to follow if you're DXing from a vehicle, though some have quite comfortable bucket seats. But getting receivers, peripheral equipment and a writing surface set up in a small vehicle with two DXers requires some improvisation. Try setting up at home first to see whether things will work out as comfortably as possible.

Sleeping accommodation is important for those of us who can't DX all the time. Tom Gavaras has DXed in a sleeping bag on a fold-out lawn chair and found it comfortable when DX was not so good and sleep beckoned, but others prefer comfortable sleeping accommodation away from the radio.

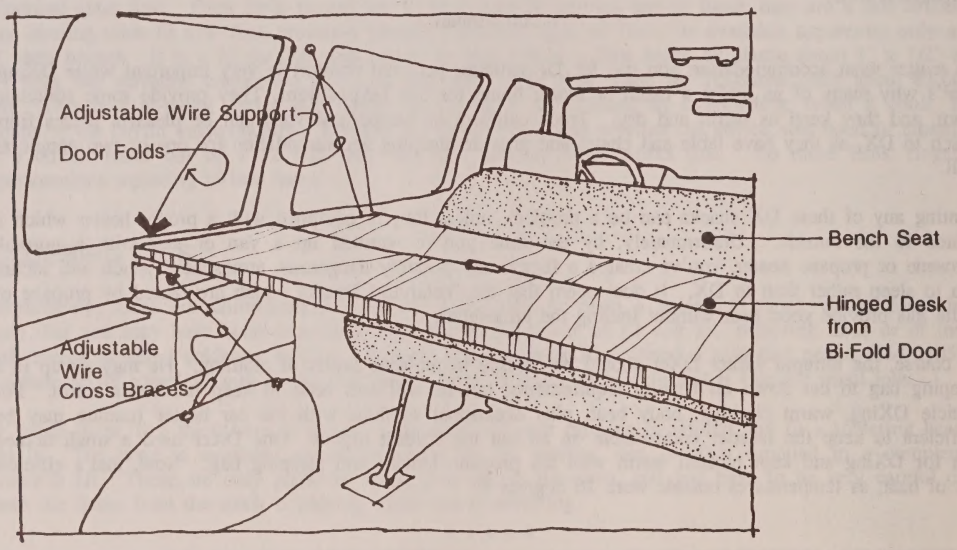
MODIFYING THE FAMILY VAN AS A DXPEDITION SHACK

Like many DXpeditions, John Bryant has used various vehicles as portable DX shacks. Though he has listened from a sedan, a pick-up, a Chevy Blazer and a van, he's never found the right combination of:

1. a large desk for the radios and log books
2. plenty of 12v power outlets
3. a nice comfortable seat

When his last clunker gave up the ghost, he decided to factor DXpeditions into the new car selection process. His new GMC Safari Van, had four bucket seats in two rows as well as a "quick disconnect" bench seat in the rear. The two middle row bucket seats were removed and, using a power reciprocating saw, the mounts of the bench seat were moved to the "middle row" position in the van. Now, when the van is is its civilian garb, the seating is two buckets up front and a forward facing bench seat in the middle. When it does the Clark Kent/Superman routine, the bench seat is disconnected, spun to face a new removable desk in the rear and reconnected in the mounting cups, a 30 second job.

The desk was fabricated from a hinged two panel "bi-fold" closet door; each panel is 15" wide. See illustration below:



REMOVABLE DX DESK AND REPOSITIONABLE SEAT IN GMC VAN

The desk, clad in plastic laminate, cost about $50, counting screws, bi-fold door, laminate and hardware, and took about 8 hours to make. The seat modification cost very little, but it took about 16-20 hours to remove and re-install the mounting cups in ;the floor pan. Care should be taken not to cut wiring, fuel or brake lines or the frame itself when moving these brackets.

Enough cigarette lighter jacks to power up DXpedition gear were provided by using Radio Shack part #270-1539. This is a female "cigarette lighter receptacle" with an integral snap-on cover. It snaps into an easily made hole in a plastic trim panel, and looks like original equipment. Two of them were wired to the battery with 12 gauge wire and in-line fuses. Works like gangbusters and cost $5.49 each.

The goal was to design the mod for quick conversion from car to DX shack, while not reducing the resale value of the van. I covered the holes in the carpet from the former mounting points with plastic laminated hardboard which matched the carpet and trim. All other mounting was done with small eye bolts which practically disappear in the carpet pile. John is very pleased with the conversion and recommends it to the "do it yourself/tinkerer/former hotrodder" segment of the DX community.

ANTENNAS

A major advantage of many DXpeditions is the availability of space to erect large and/or exotic antennas. Beverage antenna DXpeditions seem to be the most common, and there is a good section on putting up Beverage antennas by John Bryant in Proceedings 1989.

DXpeditions in quiet or ocean shore locations can be quite successful using active whips, loop antennas, simple dipoles or random wires and tuners. Most wire antennas and the active whip perform better when placed as high as possible. The usual approach is to support such antennas from trees, so you might choose your site with that in mind. Getting the antenna in the tree usually involves firing a lead weight attached to a light line up into the foliage, and hauling the wire up with the line. See Proceedings 1989, p. F12.7, for tips on putting up an antenna using a slingshot.

The number of antennas you use on an expedition will depend on the time, space and quantity of wire you have available. Overnight expeditions may need only one or two wires, while longer expeditions might include many more types and orientation of antennas. At least two types of antennas (or two Beverages in different directions) is a minimum for serious DXpeditioning. If there are several DXers, they may prefer separate antennas, or they may use splitters on several different antennas (see Proceedings 1989, pp. F12.5 and 6, for a discussion of antenna splitters).

Remember that any antenna may affect other antennas. The worst case could be a vertical antenna inducing atmospheric noise to other antennas or skewing their directional patterns. So keep antennas as widely separated as possible. Multiple antennas should be fed into the receiving area using coaxial cable (and matching transformers if necessary. See Proceedings 1988, p. A3). The antenna signals may then be split, switched or otherwise modified in the receiving area. It helps to label each end of a coaxial cable with a piece of coded masking tape, so that you can identify cables within the listening area without following each to its antenna; they can become a rat's nest at times.

Don't overdo antenna erection and experimentation if you have only limited time. Remember, you want to DX as well.

Some receivers may overload when connected to a very large antenna, and an antenna tuner or attenuator might be necessary. Unfortunately, most receivers with attenuators in the front end use large increments of attenuation when you may require only a few dB at most. Step attenuators can be found in recent ARRL Handbooks. Otherwise, antenna tuners may help to avoid problems. If you plan to DXpedition frequently, you may want to look into a receiver with better signal handling capabilities in order to get the most benefit from your big antennas.

These photos show some of the Proceedings' Northwest crew. The left photo is **John Bryant**'s "Sabbat. Camp," where he, Linda and an NRD-525 spent several months of 1990 on DXpedition. The right photo is from Shortwave Week 1990 at Grayland State Park on Washington's Pacific coast. Left to right are **Bryant, David Clark, Bruce Portzer** and **Craig Siegenthaler**.

GROUNDS

For best listening results and for added safety, receivers, accessories, and particularly antennas should be grounded. Wind and precipitation can build up static charges on antennas to surprisingly high voltages, damaging receiver components. If you are using matching transformers or have a receiver with a tuned front end (FRG-7, SPR-4 etc.) then your antenna is running to ground through an inductance. Otherwise, connecting your antenna to ground through a 1 mH RF choke may be wise. A good ground allows electrical charges to drain off equipment.

The best ground is a 5 or 6 foot rod pounded into good wet soil, but you may have to make do with dampening dry or rocky soil. Try to provide each receiver with its own ground rod, or failing that, use one ground rod with a line to each receiver, not a line from receiver to receiver and thence to ground. Such an arrangement may cause ground loops, which can lead to problems with electrical noise generated at the site.

FINAL POINTS:

1. send those great loggings into your club bulletins!
2. Man does not live by DX alone. If conditions are bad, you may want to try antenna experiments, or receiver comparisons. Failing that, wilderness DX sites often have attractions of their own, so enjoy the holiday espects of DXpeditions as well.

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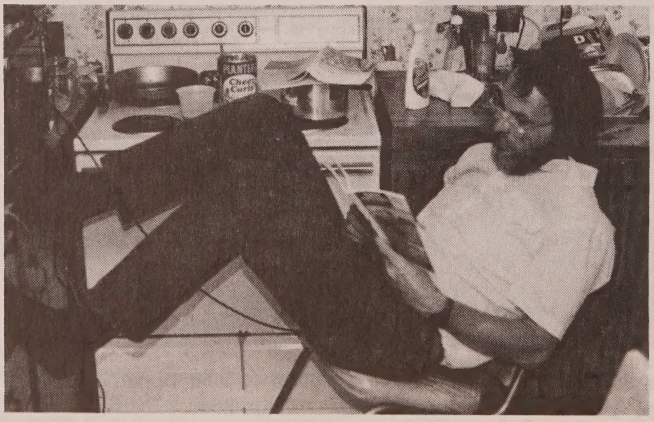
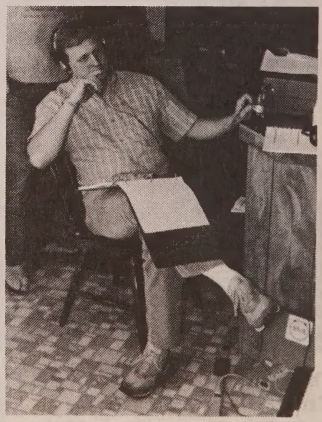
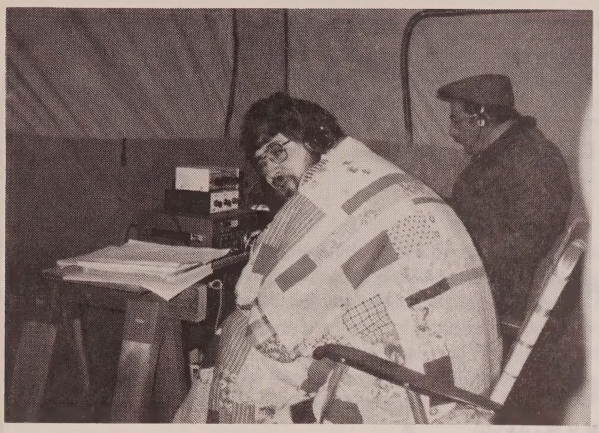
5. Proceedings 1989. Stillwater, OK: Fine Tuning Special Publications, 1989, Section A9 and F12.

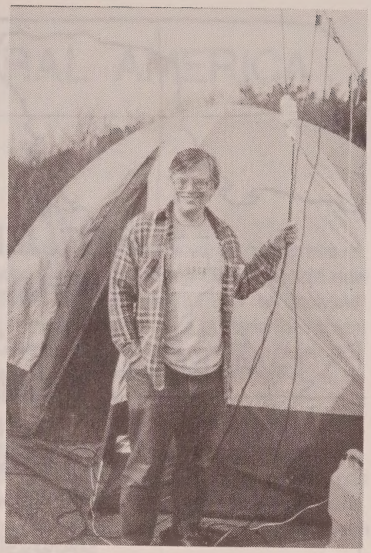
Thanks to the following for their ideas and assistance: Niel Wolfish, Paul Routenburg, Terry Palmersheim, Tim Hall, Tom Gavaras, Phil Bytheway, John Bryant and Guy Atkins.



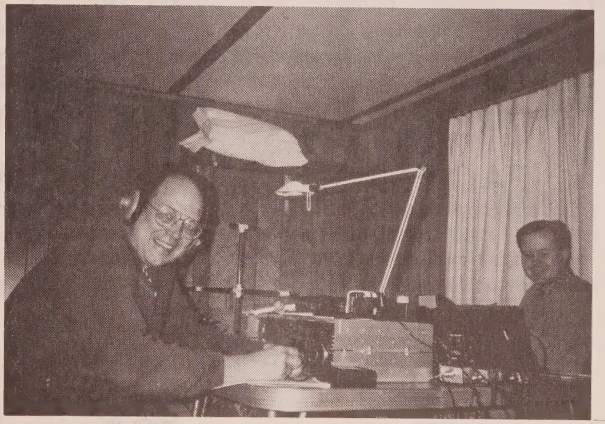


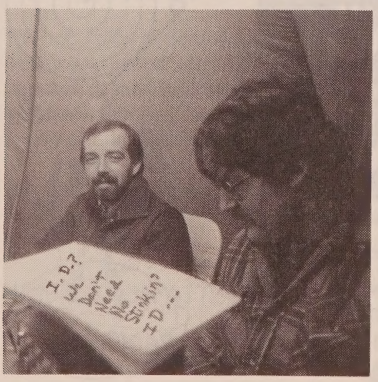
These two photos illustrate the laid back approach of some of our Virginians on DXpedition. The most laid back of them all is **Harold (Dr. DX) Cones** on the left, and **Chuck Rippel** on the right.

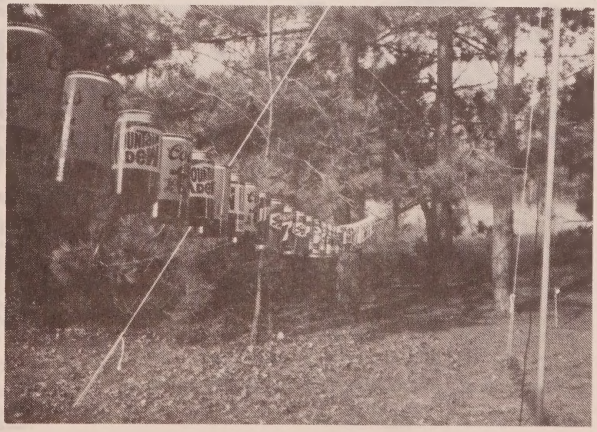


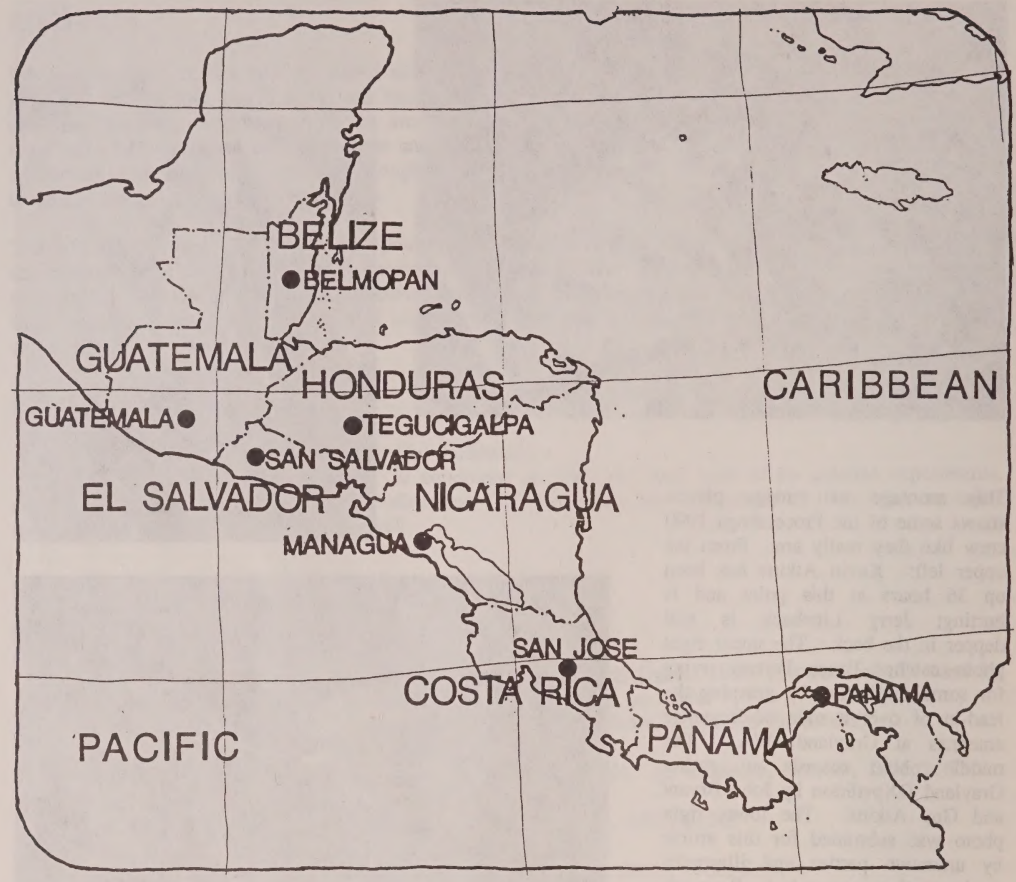


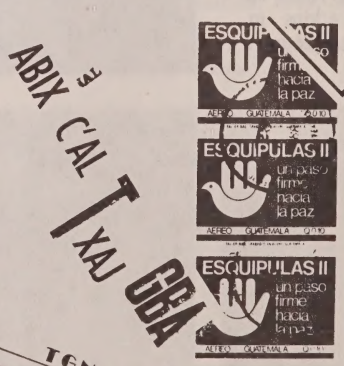
This montage of vintage photos shows some of the Proceedings 1990 crew like they really are. From the upper left: Kevin Atkins has been up 36 hours at this point and is hurting; Jerry Lineback is still dapper in the back. The upper right photo catches Bruce Portzer trying for some inspiration by grasping the lead-in of over a mile of Beverage antennas at Grayland, WA. The middle photo records an earlier Grayland DXpedition by John Bryant and Guy Atkins. The lower right photo was submitted for this article by unknown parties and illustrates an innovative approach to Beverage antenna design. FT's Kirk Allen on DXpedition with Kevin Atkins in Oklahoma rounds out our Rogue's Gallery.

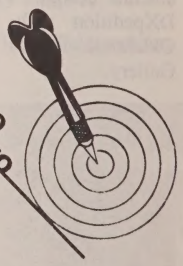












RADIO K'EKCHI'

TGVC 4.845 KHZ 60 METROS

FRAY BARTOLOME DE LAS CASAS, 16015 ALTA VERAPAZ, GUATEMALA

A DXERS TOUR OF CENTRAL AMERICA

Rich D'Angelo

Central America offers the DXer a number of interesting shortwave broadcast targets of varying degrees of difficulty. The countries of Central America provide interesting listening and the well informed DXer can add new stations to the log and many interesting verifications too. In addition to a sizable number of licensed broadcasters, the region supports a number of clandestine radio stations who target listeners outside the region as well as those within their borders. Only Panama is not represented on the shortwave bands. Therefore, this feature will focus on the six Central American countries represented on shortwave: Belize, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua.

While new stations are periodically added to the Central American lineup, the actual number of stations on shortwave in 1990 is fewer than in 1980. This is due to the slight commercial value broadcasting on shortwave has in this region. However, religious broadcasters never tire in their efforts to reach the many thousands of rural villagers and tribesman located in remote areas. Consequently, most of the recent additions to the shortwave scene in Central America are religious organizations.

This feature will provide a country by country review of shortwave broadcasting activity in each of the six Central American countries where shortwave broadcasting exists. Let's begin with some background information about the area.

LOCATION

Central America is the narrow band of land on the southern end of North America. It is bordered by Mexico on the north and Colombia on the south. On the east is the Caribbean Sea and to the west is the Pacific Ocean. The region consists of seven countries - Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama and covers 201,847 square miles or 522,781 square kilometers. The total population of Central America is approximately 30 million.

There are lowlands on both coasts of Central America. Rugged mountains crisscross the inland region. These mountain ranges make transportation very difficult. Most of the people in the region live in the highlands of mountainous areas where they earn a living on tiny farms.

THE PEOPLE

The population of Central America is very diverse. The people of Guatemala can be divided into two groups - Indians and people of mixed Spanish and Indian ancestry. Over half the country's population speak an Indian language descended from the Maya Indians. Most of the people of Honduras and El Salvador are mestizo - mixed Indian and European ancestry. Large numbers of blacks live in Belize, Nicaragua, and Panama. Costa Ricans are mainly of European descent.

The official language of Belize is English. Spanish is the official language of the rest of Central America. However, many Indians in Guatemala speak native Indian languages.

UNIFICATION ATTEMPTS

There have been numerous attempts over the years to create political unification of Central American countries. Since the early 1800's, there have been at least 25 separate efforts. All of these attempted unifications have

been short lived with most lasting only a few months.

In 1823, the United Provinces of Central America was formed. The federation consisted of Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. The people of the federation failed to develop any unity and the union dissolved in 1840 when its President, Francisco Morazan, was driven into exile. Morazan formed another union just two years later when El Salvador, Honduras, and Nicaragua created the Central American Confederation. However, the government was too weak to enforce its rule and collapsed in 1845.

The Central American Court of Justice was established in 1907 and consisted of Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. It was dissolved in 1918 when Nicaragua ignored the courts findings over disputed canal building rights. In 1921, the Central American federation was formed which united El Salvador, Guatemala, and Honduras under one central government. The federation collapsed within a year.

Despite the many failed attempts to unite politically, there have been many instances of successful regional organizations. In 1948, all the Central American countries, excluding Belize which was still under British rule as British Honduras, joined with other Latin American countries and the United States to form the Organization of American States. In 1951, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua established the Organization of Central American States which promotes cultural, economic and political understanding among the member nations. In 1960, El Salvador, Guatemala, Honduras, and Nicaragua created the Central American Common market which provides for free trade among its members. Costa Rica joined the group in 1963. It broke up after the 1969 war between El Salvador and Honduras.

BELIZE

The former English colony of British Honduras was granted self government in 1964. It was renamed Belize in 1973 and achieved independence as a member of the British Commonwealth of Nations in 1981. It is bordered by Mexico to the north, Guatemala to the south and west, and the Caribbean Sea to the east.

BROADCASTING IN BELIZE

The Belize Broadcasting Network is the government operated, semi-commercial broadcasting system that provides all the broadcasting activities in the country. A series of 4 medium wave, 2 FM and one shortwave station cover the country. There are no television stations in Belize.

Belize Radio One

In 1952, Radio Station ZIK - 2 was founded with the technical assistance of the British government. The transmitter was made in London and operated at a power of 5 kilowatts on 3,300 kHz. Although no longer in use, that transmitter is still operational and located in the outskirts of Belize
City. In 1957, the stations name was changed to the British Honduras
Broadcasting Service. In 1961, a new shortwave transmitter was inaugurated in Ladyville just north of Belize City. In 1976n it was moved to Belmopan which is approximately 50 miles or 80 kilometers southwest of Belize City. The transmitter is a Collins EA20 capable of 1 kilowatt output into a half wave dipole antenna. In 1972, the station changed its name to Radio Belize. This was followed by a name change in 1986 to the currently used Belize Radio One.

Most programming is in English and Spanish. Also, there are cultural programs in vernaculars. Typical programming for Belize Radio One consists of News and information programs, educational features, agricultural reports, religious services, children's programs, and obituaries. The main purpose of the shortwave outlet is to cover parts of Belize where medium wave or FM signals are not well received. The station also provides the latest weather reports to ships in the Caribbean basin. The station is scheduled to operate from 1100 to 0500 UTC on a frequency of 3,285 kHz. Reports of their shortwave operation can best be classified as "erratic". The station has been off the air since June 1989. It is expected to return to shortwave sometime during 1990.

In recent years, the station has not been well heard due to problems with the transmitter. However, Belize Radio One has been a good verifier of listener reception reports over the years. Their oversized map card has not changed in over 25 years! Reports in English with return postage in the form of mint stamps or International Reply Coupons (IRC's) should be addressed to P. O. Box 89, Belize City, Belize.

COSTA RICA

Rumors of huge gold deposits lead Spanish explorers to the "rich coast" area in 1502. However, the Spaniards found little mineral wealth there. Costa Rica remained a Spanish colony until 1821 when Costa Rica and the other Central American colonies broke away from Spanish rule. It is bordered by Nicaragua in the north, Panama and the Caribbean Sea in the east, and the Pacific Ocean in the south and west.

BROADCASTING IN COSTA RICA

The country has a variety of medium wave stations with many of them based in the San Jose area. There are almost 500 thousand television sets in this country of 3 million people. There are five networks providing television on 6 channels. Although shortwave has little commercial value, the country has a number of shortwave broadcasters. Most of the recent additions are religious outfits. However, Radio Exterior de Espana plans to build a relay station in Costa Rica in the near future.

Radio Reloj (TIHB)

In 1945 Sr. Roger Barahona Gomez began broadcasting with a small station he named Radio Cristal. In 1952, Radio Cristal began shortwave broadcasting on 6,006 kHz. The station put out a good signal and reception reports were received from around the world. In February 1958, the stations name was changed to Radio Reloj. By 1962, the Barahona Family formed "Sistema Radiofonica HB" with the acquisition of a second radio station. By 1969, a second shortwave station began operating on 4,832 kHz using the name Radio Capital. Over time the two services were consolidated into the present Radio Reloj operation.

Radio Reloj operates two Elcor VT - 2V transmitters utilizing 2,500 watts each for shortwave broadcasts on 4,832 kHz and 6,006 kHz. Each transmitter is connected to a half wave dipole antenna. The transmitter site is located in San Antonio Parado which is approximately 5 miles or 8 kilometers away from the station's San Jose studios. In 1989, the stations shortwave transmitter on 4,832 kHz went off the air. However, 1990 has seen the reactivation of this classic Costa Rican shortwave station to the delight of many listeners.

The station broadcasts exact time checks during their music and social service programs. The social service programs provide listeners an opportunity to broadcast free messages to the community. In 1970, the station introduced a feature called "Aeronoticias" which informed listeners of domestic and international flight information from El Coco Airport. The station's frequent identifications make them an easy target to spot on the shortwave bands.

Radio Reloj is an inconsistent verifier. Their familiar globe QSL card is in the collection of many DXers. Unfortunately, many DXers have expressed disappointment about unanswered letters. Reports in Spanish with return postage in either mint stamps or a US$1.00 should be sent to Radio Reloj, Apartado 341, 1000 San Jose, Costa Rica.

Radio Columbia (TILX)

Founded in July 1964 as a medium wave station by Sr. Francisco Cordoba, Radio Columbia branched off into the world of shortwave broadcasting in the latter part of 1983. TILX was first known for the many different frequencies it utilized - 4,825 kHz; 4,840 kHz; 5,010 kHz; and finally 4,850 kHz.

Its major news effort was Noticieros Columbia. Radio Columbia also featured short news summaries every thirty minutes. While on shortwave, it employed 13 people in the news department. The principle reason for shortwave

broadcasting was to convey a complete picture of democratic countries to other non-democratic countries in Central America. Because of its size, Costa Rica doesn't need shortwave to cover the population with broadcast information. Essentially, Radio Columbia was an external service.

Radio Columbia used an Elcor BT - 20 transmitter with a 2 element quad antenna. The transmitter has a potential of 20 kilowatts. The station was a good verifier with receptionist and v/s Rossy Cordero being a well known name in DX circles. The WRTH still lists this station in the 1990 edition, however it is listed as inactive. The shortwave transmitter is broken and repairing it is not a priority. Perhaps they will return to the shortwave bands once again. One never knows about the Latin stations. If they do return to shortwave, Spanish language reception reports with return postage in the form of mint stamps should be sent to the station at Radio Columbia, Apartado 708, 1000 San Jose, Costa Rica.

Faro del Caribe (TIFC)

This station was founded in February 1948 by the Mision Latinoamericana as the first cultural station in Costa Rica. Today, TIFC is a religious broadcaster with most of its programing in Spanish. There is a daily hour of English programing at 0300 UTC. In addition to religious fare the station offers a wide variety of cultural programs.

Faro del Caribe, or The Lighthouse of the Caribbean in English, has three control rooms or studios. The first holds a Gates console mixer, an Ampex open tape deck, two Gates disk players and a TEAC cassette tape deck. The second studio contains an Internacional Tapetronics Corporacion console mixer, a TEAC A303 cassette tape deck, two Broadcasting Electronics cartridges, and an ATR - 700 open tape deck. The third studio contains a Broadcasting Electronics console mixer, two Internacional Tapetronics Corporaci" n disk players, a Realistic SCT - 29 tape deck, and three Broadcasting Electronics cartridge tape decks. This studio is used for live programs.

Faro del Caribe operates on three shortwave frequencies. A five kilowatt RCA transmitter using a horizontal arch antenna with three towers is used on 5,055 kHz. It is used to cover all of Costa Rica and much of Central America and is well heard throughout North America. A 2.5 kilowatt CCA AM-2500 transmitter is used on 6,175 kHz for their morning service. It is well received in remote areas of the country. The 9,645 kHz channel uses a 1960 vintage transmitter with only 500 watts into a 1/2 wave dipole. The schedule is 1000 - 2000 UTC, and 2300 - 0600 UTC with English between 0300 - 0400 UTC. The 49 meter band outlet is used between 1000 and 2000 UTC. the 31 meter band channel is used 1000 - 1800 UTC and on an irregular basis from 2300 to 0400 UTC.

The station is a quite friendly and has an English Correspondence Department, therefore requests for verification cards can be sent in English. The Lighthouse of the Caribbean issues a full data QSL verification card and is glad to receive reports from places where their signal is heard. Reception reports with mint stamps should be sent to Gerente Juan J. Ochoa F. at Faro del Caribe, Apartado 2710, 1000 San Jose, Costa Rica.

Radio Impacto (TIRI)

In April 1983, Radio Impacto bought the frequency license of Radio Atenea a medium wave and shortwave station that specialized in playing Salsa music. Frequency licenses are issued by the Ministry of Communications in each province and are difficult to obtain due to spectrum agreements with neighboring countries in Central America. Consequently, these licenses are very valuable.

Initially, Radio Impacto was a music station playing Spanish pops music 90% of their broadcast day. Due to station personnel problems, the station ended their 24 hour service in 1984. The station began anti-Sandinista news broadcasts in September 1983 aimed at Nicaragua. This and other anti-Sandinista programming has created some friction in the region. Although they carry commercial announcements, many DXers classify this station as a partial clandestine operation. It's goals appear politically oriented. The shortwave service is a democracy propaganda machine aimed at a Nicaragua audience. The station is an outspoken critic of the Sandinista government in Nicaragua. It is said that the station is run by anti-Sandinista's with close ties to the FDN. DXers visiting the station have encountered a top secret atmosphere. This station targets a Nicaraguan audience. There is very little emphasis placed on the domestic audience by the shortwave service.

Radio Impacto operates in the 49 meter band. Generally, it can be found operating its 20 kilowatt Elcor transmitter on 6,150 kHz. However, it has been known to move around in this band. Moves to 6,140 kHz and 6,160 kHz have occurred over the years due to interference. In late 1987, Radio Impacto introduced a new frequency in the 60 meter tropical band of 5,030 kHz. This new outlet puts out a booming signal. During 1989 and 1990, this frequency has been changed to 5,044 kHz for short periods of time. These unexplained events usually occur with a shift by Radio Catolica in Ecuador shifting from its usual 5,040 kHz channel to 5,030 kHz. Confusing and interesting. This keeps clandestine radio enthusiasts busy. In May 1990, the station went off the air. Perhaps the changes in Nicaragua have eliminated the need for this broadcaster. The station is for sale and the future of further shortwave broadcasting is in doubt.

The station has had an on-again off-again attitude about verifications. At first, Radio Impacto was an excellent QSLer. However, some staff changes lead to the station becoming a non-verifier for a period of time. Recently, TIRI verie signer Hector Requena C. has been responding to listeners letters. Spanish language reception reports with return postage in the form of mint stamps should be sent to Radio Impacto, 497 San Pedro de Montes de Oca, 25 m suroeste del higueron, San Jose, Costa Rica.

Radio Casino (TIQ)

Puerto Limon's most popular radio station began from a very modest medium wave radio operation. Today, Radio Casino operates on medium wave, FM and shortwave. Radio Casino was the discovery of three radio enthusiasts in 1945. It began operations with only a 200 watt homebrew transmitter on 555 kHz. The AM frequency changed to 1,175 kHz before ultimately ending up on its present 1,220 kHz channel. In 1955, shortwave was added in order to reach remote areas along the Atlantic coast.

Radio Casino features a wide variety of news, music, sports, religious (Sundays) and entertainment programming in Spanish and English. Its English programs contribute to the station's popularity with the black, Jamaican communities located in this region. The station operates on 5,954 kHz with only 700 watts power and operates from 1030 - 0600 UTC. English programs are carried from 2300 - 0000 UTC and from 0400 - 0600 UTC. The station's low power and frequency location make it a difficult catch in the low end of the 49 meter band.

Traditionally, the station has been a good verifier with Radio Casino pennants displayed in many DXers shacks. Since the station does employ English speaking personnel, reports in Spanish or English are acceptable provided they contain return postage in the form of mint stamps. Station owner Luis Grau will be glad to receive your reports at Radio Casino, Apartado 287, Puerto Limon, Costa Rica.

Adventist World Radio (TIASD)

The station began operations in September 1987 with two heavily modified Consasa five kilowatt transmitters using a Kenwood TS - 430S exciter and an Eimac 4CX5000 final tube. Two five element Yagi antennas with 12 db gain are used on 15,460 kHz and 11,870 kHz. The 31 meter band and 49 meter band outlets use dipole antennas. The station also uses two towers; one self-supporting structure of 32 meters; the other a 36 meter guyed structure. During 1989, two new Elco transmitters were placed into service. One is a 40 kilowatt unit using a Log Periodic antenna; the other is a 5 kilowatt unit using a 5 element Yagi antenna.

AWR - Latin America is predominantly a religious broadcaster. However, it features a number of health, informational, and medical features in Spanish, French and English. The station operates daily from 1100 - 1500 UTC and from 2300 - 0500 UTC. French is heard between 1100 - 1200 UTC; English is heard between 1200 1400 UTC and 2300 - 0100 UTC; and Spanish is heard between 1400 - 1500 UTC and 0100 - 0500 UTC. This schedule is subject to many variations. The 5 kilowatt transmitter is used for broadcasts to Central America on 11,870 kHz. The 40 kilowatt transmitter on 9,725 kHz is used for broadcasting to North and Central America. The staff consists of a Manager/Chief Engineer, a Program Director, three Secretaries and several operators. Because the station is located on the grounds of the Seventh-day Adventist College, the station is able to get help from several students. The AWR facilities in Costa Rica were designed to be the main production facilities for Adventist World Radio - Latin America. These studios produce large portions of the programming for here and Guatemala. AWR has a

recording studio and two on air studios at this facility.

The station is an excellent verifier with Station Manager and Chief Engineer David L. Gregory responding to listeners letters and reports. English language reception reports with return postage can be sent to Adventist World Radio, TIASD Radio Lira, Apartado 1177, 4050 Alajuela, Costa Rica.

Radio Rumbo (TICAL)

Another Costa Rican shortwave station that is currently inactive is Radio Rumbos. This station was very popular in the early 1980's with its well known singing potato QSL card finding its way into many DXers shacks. The potato is symbolic of potato production in the Cartago region of Costa Rica. The station was founded in May 1966 and has had occasional runs on shortwave. Consequently, it bears watching as a potential shortwave target in the future.

The shortwave transmitter was made by the stations Gerente, Sr. Carlos Alberto Lafuente. It had a one kilowatt output into a 1/4 wave antenna using the nominal frequency of 6,075 kHz. When operating the stations frequency was subject to drifting and was frequently reported as 6,072 kHz. The station was principally a music station which is unlike other Costa Rican stations that broadcast news and information for a Nicaraguan audience. The WRTH lists the medium wave stations operating hours as 1100 - 0600 UTC with a note indicating "also on shortwave". Could a resumption of shortwave broadcasts be in the future of Radio Rumbo? If they do return, it will reflect the gerente's keen interest in shortwave. The station can be reached at Apartado 140, 7050 Cartago, Costa Rica.

Radio Universidad de Costa Rica (TIUCR)

This is the least frequently heard station of all the active Costa Ricans on shortwave. Its low power, frequency selection and schedule combine to make this a difficult DX catch. It was founded in November 1948.

Radio Universidad is a University station; something only Mexico shares in common with the Central American countries. Its purpose is to provide culture and education through radio. It is located only fifteen minutes from San Jose in San Pedro Montes de Oca. Programs consist of culture, education, agriculture, entertainment, and classical music. They depend on transcription tape services of many international broadcasters such as the BBC, Radio Canada International, Radio Japan, VOA, etc. The station is scheduled from 1300 - 0400 UTC in a very congested 49 meter band on 6,105 kHz. Their late sign-on time makes North American reception very rare. Recent field reports indicate the station is off the air. A new station manager has indicated an interest in returning to shortwave. However, the station will have to reconstruct the antenna and do minor maintaince work on the transmitter.

The station's equipment consists of a disk library, a fully equipped broadcasting studio and a recording studio. By Latin standards, their equipment is new. Their two kilowatt Elcor BT - 2 transmitter is connected to a 1/4 wave dipole antenna.

TIUCR is a tough station to hear, however, if you are fortunate to log this one try sending a Spanish report with mint stamps to Director Jose Tasies Solis at Radio Universidad de Costa Rica, Apartado 2198, 1000 San Jose, Costa Rica.

Radio For Peace International

In 1979, Dr. Rodrigo Carazo, President of Costa Rica from 1978 - 1982, presented the concept of a University for Peace to the General Assembly of the United Nations. In 1980, the United Nations unanimously adopted a resolution to establish The University for Peace in Costa Rica as an independent institution in both program and funding. The World Peace University was incorporated as a nonprofit educational corporation in December 1980. It opened its doors for classes in October 1985. The radio station is a joint project of the World Peace University in Eugene, Oregon USA and the University for Peace in Ciudad Colon, Costa Rica. RFPI broadcasts from the campus of the University for Peace commenced in September 1987.

RFPI is operated by a six member Board of Directors comprised of three members appointed by each university. It operates on an autonomous financial basis, supported entirely from private donations, program fees, and listener support. Programming consists of a mix of interviews, talk shows, dialogues, information exchange, news analysis, a wide variety of music, poetry, plays, cultural exchanges, as well as courses from the two universities. They are the only station in Central America to carry Glenn Hauser's World of Radio program. The majority of the programming is in English with two hours of Spanish programming on a daily basis and two hours of French programs on a weekly basis. The station estimates that approximately 35,000 listeners tune in their station on a daily basis.

The station is staffed entirely by volunteers. It is an international and multilingual staff. The two transmitters were built by the staff and are used to simulcast program material on two bands. The station uses four bands during the day to optimize reception. Six element and three element Yagi antennas are rotated on their 35 meter tower for broadcasts to North America, Europe, and the South Pacific. A bidirectional two element antenna provides coverage to Central and South America. The effective radiated power on 21,565 kHz and 7,375 kHz is 26 kilowatts. The effective radiated power on 25,495 kHz and 13,660 kHz is 16 kilowatts. The stations schedule and frequency selections are variable and subject to seasonal changes. Recently, an upper sideband broadcast on 7,375 kHz has been well heard in North America between 0030 - 0400 UTC.

Radio for Peace International is a good verifier. English language reception reports with return postage can be sent to Station Manager and verie signer James Latham at Radio for Peace International, P. O. Box 10869, Eugene, OR 97440, USA or Apartado 88, Santa Ana, Costa Rica.

EL SALVADOR

El Salvador is the smallest Central American country in area. However, it has more people than any other nation in the region except Guatemala. It is the most densely populated mainland in the Western Hemisphere. The country is bordered by the Pacific Ocean to the south, Guatemala to the northwest and Honduras to the northeast.

BROADCASTING IN EL SALVADOR

A majority of families own one or more radios. Most broadcasting is on the AM broadcast band. No official radio broadcasts are on shortwave at the moment. However, shortwave has been a very successful form of communication for the guerillas fighters in the country. There are over 400 thousand television sets and 4 TV networks in the country. Also, there are six daily newspapers in the country.

YSSS Radio El Salvador

In 1926 the government's radio voice, Radiodifusora Nacional de El Salvador was established with the call sign AQM. The call sign of the station is taken from the the initials of then President Alfonso Quinonez Molina. The station used a 500 watt transmitter on a frequency of 636 kHz. In 1927 the call sign was changed to RUS to avoid a conflict with Norwegian call sign prefix allocations under the International Radiotelegraphic Agreement. The call sign was changed in 1933 to RDN - Radio Difusora Nacional. In 1936 the call sign and station name were changed to YSS - Radio Nacional de El Salvador.

On March 1, 1953, Radio Nacional de El Salvador began an external service on shortwave using two 5 kilowatt transmitters on the frequencies of 9,555 kHz and 5,950 kHz. This external service was heard worldwide as indicated by the volume and diversity of the mail. After struggling for many years, the shortwave transmitters were taken off the air in 1976 due to a lack of spare parts. However, from time to time the station is reported to be back on the air. Therefore, checking their well known frequencies could yield a surprise log. In 1978, the station's name was changed once again to YSSS - Radio El Salvador. It's purpose is to provide cultural, informational, and social programming as well as spread government opinion in the country.

There are no plans for the station to reactivate shortwave broadcasts in the near future. However, if the station does surprise the world by fixing an old, broken down shortwave transmitter, then address those reception reports

to the station at YSSS Radio El Salvador, Parque Venustiano Carranza, San Salvador, El Salvador.

Radio Venceremos

Characteristic of the turmoil of the region is the guerilla shortwave station Radio Venceremos. The station claims to broadcast from Morazan Department in El Salvador and is operated by the Farabundo Marti National Liberation Front (FMLN). During the many years of struggle that has engulfed this country, the station has been visited on a number of occasion by broadcasters and journalists. The broadcasters and journalists support the claim of the station's location. That makes Radio Venceremos a shortwave broadcast station from El Salvador.

Radio Venceremos broadcasts the typically anti-government fare associated with clandestine radio stations. Programs are broadcast numerous times during the day. Typical scheduling shows broadcasts at 0000 - 0115 UTC, 0200 - 0315 UTC, and 1215 - 1315 UTC using 6,835 kHz, 6,340 kHz, and 5,550 kHz. Typically, the stations frequency is "adjusted" during the course of the broadcast to avoid jamming activity. Currently, a popular frequency range for this station is between 6,830 - 6,900 kHz. Once logged, be prepared to chase after this stations as it seeks to avoid the jammer. On special occasions, this station and Radio Farabundo Marti link up and provide joint programming.

Over the years, Radio Venceremos has given a Mexico City address over the air. Very few QSL's have been reported through this location. A more successful route has been through a New York City address which has yielded a number of replies in 1989 and 1990 from v/s Anita Ocampo, Correspondent of Radio Venceremos in the USA. Reports can be in English and should contain return postage or an self-addressed, stamped envelope and a prepared QSL card. The address is Radio Venceremos, c/o El Salvador Media Project, 335 West 38th Street, 5th Floor, New York, NY 10018, USA.

Radio Farabundo Marti

Another long time anti-government station claiming to be located in Northern Chalatenango Province is Radio Farabundo Marti. Founded on January 22, 1982, the station operates under constant military attack forcing it to move its location to avoid destruction by the El Salvador government.

The station broadcasts news, cultural and educational programs designed to reflect their struggle for social change. The station relies on a network of "popular correspondents" scattered across the nation to feed it information on events in all parts of El Salvador. Many of the correspondents live among the general population. Often they accompany the guerrillas into battle. The station hopes to resume FM broadcasts because the majority of El Salvadorians lack access to shortwave receivers. In October 1988, the El Salvador Radio Aid Project was formed to provide material and financial support for Radio Farabundo Marti.

The station has operated at times and in frequency ranges similar to Radio Venceremos. They are nominally scheduled to operate from 1200 - 1300 UTC, and 2300 - 2400 UTC between 6,600 kHz and 6,750 kHz. However, their broadcasts frequently last to 0200 UTC and beyond. Like many clandestine stations, finding a good address for QSL's can be difficult. Earlier this year, a new address for this elusive verifier has popped up. A prepared card with an SASE to Radio Farabundo Marti's US Representative and verie signer Jaime Suriano should be sent to the El Salvador Radio Aid Project, P. O. Box 1614, Old Chelsea Station, New York, NY 10011, USA.

GUATEMALA

More people live in this Central American country than any other. Most of its people live in the mountains in the central part of the country. Its capital, Guatemala City, is located in this region and it is the largest city in Central America. Almost half of the people are Indians, ancestors of the Mayans, whose customs and way of life differs from that of other Guatemalans. The country is bordered by the Pacific Ocean on the south, Mexico to the west and north, Belize to the northeast, the Caribbean Sea to the east and El Salvador and Honduras to the east and southeast.

BROADCASTING IN GUATEMALA

The country's nearly 10 million people are served by 10 daily newspapers, most of which are privately owned. The postal, telegraph, and telephone systems are government operated and provide service only to the cities and towns. Therefore, radio is extremely important in the many rural regions of the country. On average, there is one radio for every 20 people in the country.

Guatemala provides the DX listener with many of the more exotic catches from Central America. The diverse blends of music, Indian languages and culture make Guatemala a choice DX target for those interested in DXing the Latins. Some of the stations are relatively easy while others present a very difficult task for even the most experienced hobbyist. The World Radio TV Handbook ("WRTH") lists twelve different shortwave broadcast outlets in Guatemala.

Future rural broadcasting stations in this country will undoubtedly be shortwave outlets. There is a freeze on medium wave stations due to the severe overcrowding on that band. Also, the FM band is impractical in this mountainous country. Many years ago, the Ministerio de Comunicaciones y Obras Publicas prohibited commercial shortwave transmissions. Prior to that prohibition there were many commercial Guatemalan stations broadcasting in the 49 meter band. Religious broadcasters have made the country a battle ground with the Evangelists making inroads into this predominately Catholic country. Since commercial shortwave broadcasting is prohibited by law in Guatemala, the new shortwave outlets will most likely be sponsored by religious organizations. In fact, the most recent additions to the Guatemalan shortwave community were Evangelist stations Radio Buenas Nuevas and Radio K'ekchi'.

Generally speaking, the shortwave broadcasters of Guatemala are good verifiers. Spanish language reception reports accompanied by return postage in the form of Guatemalan mint stamps should yield very good results from this country. Many stations provide pennants, station stickers, schedules, pins, buttons and other mementos thereby making this country a favorite among QSL hounds.

Radio Mam (TGMN)

This station began operating on 11 January 1975 as an inspirational Christian broadcaster. This catholic station is designed to serve the cultural needs of the Guatemalan peasants ("campesinos") and the Mam Indians of the area. The station is located in Cabrican which is some 300 meters above sea level in the mountains of Quetaltenango Department. Most of the inhabitants of the area are descendants of the Mayans and speak Mam.

Radio Mam broadcasts on 4,825 kHz with a power of 1,000 watts. Broadcast times are from 1300 to 1700 UTC and from 2000 to 2330 UTC. Occasionally the station stays on later and these late sign-off times provide an excellent opportunity to log and QSL this station. The types of programs carried by Radio Mam include: agriculture; health and education in the home; youth and family; religion; Maya culture; Guatemalan music and variety; and news and greetings. The station is affiliated with the Federacion Guatemalteca de Escuelas Radiofonicas ("FGER") and the Asociacion Latinoamericana de Educacion Radiofonica ("ALER").

Radio Mam is a good verifier. Station Director Jose Benito Escalante Ramos can be reached at Radio Mam, Escuelas Radiofonicas, Municipio de Cabrican, Dept. Quezaltenango, Guatemala.

Union Radio (TGMUA, TGMUB)

In recent years this broadcaster has been relatively inactive on shortwave. Operated by the Seventh Day Adventist Church, Union Radio operates on 5,980 kHz under the call sign TGMUA and on 6,090 kHz with the call sign TGMUB. Both channels use the same 10,000 watts transmitter. According to the WRTH the nominal broadcasting hours on 5,980 kHz is 1100 - 1300 UTC and 0030 - 0500 UTC and on 6,090 kHz from 1045 - 1300 UTC and 0000 - 0400 UTC. Despite its irregular appearance on the shortwave bands this station seems to manage to make it on the air around the Christmas holiday season.

Until AWR - Latin America opened up another outlet in Costa Rica, this was the main AWR station in Central

America. The station is equipped with some of the most modern equipment of any Guatemalan broadcaster. Its medium wave outlet on 1330 kHz carries advertisements every thirty minutes. The revenue generated from these ads is used to support station operations.

Like most AWR outlets this station is a good verifier. Reports generally receive a letter, a QSL card and a calendar from their Operations Director. Address reports to Union Radio, Adventist World Radio, Apartado 51 - C, Guatemala City, Guatemala.

Radio Cultural (TGNC, TGNA)

This Evangelist station is usually one of the first Guatemalan shortwave stations in most DXers logbooks. Their regular schedule, clear channel, regular English broadcasts, and strong signal combine to make this happen.

The station was founded in August 1950 by a Harold Van Broekhoven of the Central American Mission. Initially, Radio Cultural broadcast only on medium wave using 730 kHz. In 1955, Radio Cultural added an International Radio Electronics 5 kilowatt transmitter operating in the 25 and 31 meter bands. Later this transmitter was switched to the present 5,995 kHz channel. Later, a 10 kilowatt Collins transmitter was obtained. However, repairs and maintenance are expensive and this transmitter is frequently out of service. In 1970, current Chief Engineer Wayne Berger modified an old 10 kilowatt medium wave transmitter utilizing a half-wave dipole antenna to successfully cover all of Central America on 3,300 kHz.

Radio Cultural broadcasts on 3,300 kHz, and the rarely heard 5,955 kHz, from 1000 - 0700 UTC. The stations objectives are to provide spiritual uplift, evangelism and education. The programming is predominately of a religious nature. Some of the features include: bible teachings, sacred music, religious messages inserted in secular music programs, advisory programs, cultural and education items, classical music, and national and international news. Most of their programs are directed to the poor and needy. Most of the programming is in Spanish. However there are some local Indian language features and unlike most of the Guatemalan broadcasters on shortwave, this station carries a regular English language segment from 0300 - 0430 UTC daily. These English features are produced by North American religious organizations and are targeted to missionaries working in Central America.

Radio Cultural is a good verifier. Reception reports, in English or Spanish, should be sent to their QSL Secretary at Radio Cultural, Apartado 601, Guatemala City, Guatemala.

La Voz de Nahuala (TGVN)

Founded 21 November 1962, this Catholic station celebrated its 25th anniversary in 1987 proclaiming 25 years of service to the local community. The station carries out its public service obligations by offering a blend of cultural, educational and religious programs. It was the first cultural-educational station for the farmers in Solola Department. Specific program themes include agriculture, farming, health, the Catholic religion, rural living, the family and Maya culture. La Voz de Nahuala also carries music and recreational programs. Their educational programs are for teaching the campesinos to learn to read and write.

La Voz de Nahuala uses a Brasil Philips 20A-3 transmitter and a horizontal 1/2 wave three tower antenna. Broadcasting on 3,360 kHz with 1 kilowatt, La Voz de Nahuala is regularly heard in North America. Targeting to the Quiche and Cakchiquel Indian groups this station broadcasts about 95% of its programs in the Quiche and Cakchiquel languages. The remaining 5% are in Spanish. They broadcast Monday through Saturday from 1100 - 1400 UTC and from 2100 - 0300 UTC. On Sunday they broadcast from 1100 - 1400 UTC and from 1900 - 0300 UTC. On occassion the station has appeared on 5,040 kHz.

The station responds to reception reports with a full data personal letter from the Director de Programacion, Sr. Diego Adrain Guarchaj Ajtzalam or Juan Fidel Leppe Juarez. Frequently the station responds with a nice station pennant. Address those reception reports to La Voz de Nahuala, Nahuala, Departamento de Solola, Guatemala.

Radio Maya de Barillas (TGBA)

This Evangelist broadcaster targets one of the smaller Indian groups, the Canjobels, for its programs. Founded in 1962 by American Evangelist Missionaries, Radio Maya de Barillas broadcasts a variety of health, educational and cultural programs designed for the Indian peasants in the northwest reaches of the country. Much of the programming is in the Indian language - K'anjobal. However, the station does broadcast daily in Spanish from 0230 - 0330 UTC. The station operates on 2,360 kHz from 1030 - 1500 UTC and 2230 - 0330 UTC and on 3,325 kHz from 1000 - 1500 UTC and 2200 - 0400 UTC. Both outlets use a 1 kilowatt transmitter. The 120 meter band channel is infrequently reported.

The station responds to reception reports with a short no data personal letter response from Baltazar Juan, Sub gerente. Address reception reports to the station at Radio Maya de Barillas, 13026 Barillis, Departamento de Huehuetenango, Guatemala.

Radio Buenas Nuevas (TGMI)

This station is a recent edition to the Guatemalan shortwave broadcasting scene. With only 250 watts this station commenced broadcasting on 25 July 1987 with only a provisional antenna. However, by the 28th of January of the next year they were running at 1,000 watts and their tower antenna was in service.

The station is owned by "La Iglesia Evangelica Nacional Mam C.A." which is a combination of 29 churches established in various sites in the departments of San Marcos, Huehuetanango and Quetzaltenango. Most of the 500,000 native residents in these areas speak Mam. Radio Buenas Nuevas itself is located near San Sebastian H. which is some 276 kilometers northwest of Guatemala City.

The station broadcasts on 4,800 kHz from 1200 - 1330 UTC in the mornings and from 2300 - 0100 UTC during the evenings. All programs are in the Mam language. However, the station does identify in Spanish. In the future Radio Buenas Nuevas hopes to add more programs in other languages indigenous to Guatemala.

The station has only three full-time employees. Israel Rodas M. is 36 years old, married and the father of four. He is the station manager ("Gerente") and verie signer for Radio Buenas Nuevas. The rest of the staff consists of Andres Maldonado Lopez, who is married with five children and 50 years old and Gonzalo Lopez R., who is married and 43 years old.

The station doesn't have its own QSL card. In the future they hope to have one, plus pennants. Reception reports should be addressed to Gerente Israel Rodas M. at Radio Buenas Nuevas, 13020 San Sebastian H., Huehuetenango, Guatemala.

Radio Chortis (TGCH)

Broadcasting on 3,380 kHz with a power of 1 kilowatt, Radio Chortis can be heard regularly during the North American winter. The station uses a Collins 20 V - 3 transmitter and a horizontal, half-wave dipole that is 21 meters in height.

The station's purpose is to broadcast cultural programs and to teach reading and writing. Some program themes include: primary reading, reading and writing, popular music and advise, religious features, agriculture, family, regional music with advise, and education or radio school programs ("escuelas radiofonicas"). The station signs on at 2200 UTC and closes down at 0300 UTC. The programming lineup is the same Monday through Friday with various variety features broadcast on Saturday and Sunday. Most of the programming is in Spanish.

Radio Chortis has two studios. One is used for daily broadcasting while the other serves as a production studio. Radio Netherlands donated the latter facility in 1980. Both studios are equipped with LSB console mixers, RCA microphones, Ampex ATR-700 open tape decks, Russco disc players and Technics M - 215 cassette tape decks. They also have a large sound proof room for live musical performances.

The stations "Director Ejecutivo", Juan Maria Boxus, responds to listeners reception reports with a full data form letter. Address reports to Radio Chortis y Escuelas Radiofonicas, Centro Social, Jocotan, Departamento de Chiquimula, Guatemala.

Radio Tezulutlan (TGTZ)

This station was founded on 15 January 1975 by Monsenor Juan Gerardi as a Catholic religious broadcaster. Its founder was the Bishop in Verapaz. Radio Tezulutlan is a Catholic station owned by the Iglesia Diocesano which supplies most of the stations operating funds.

In 1975 the station commenced operating on 4,835 kHz using a Marti Electronics RTP-1 Serie 1033 transmitter with 1 kilowatt into a half wave length antenna. Later in 1977 they carried out tests on 2,340 kHz which was designed to broadcast in Spanish, K'ekchi', and Pocomchi. There were few listeners to this 120 meter band outlet so regular broadcasts never materialized. By the end of 1977, the station began a 1 kilowatt transmission on 3,370 kHz. The frequencies of 4835 kHz and 3370 kHz are still in use today by the station. In 1980, the 60 meter band transmitter was replaced with an International Electronics 2500AX while the 90 meter band transmitter was replaced with an International Electronics 5000AX. The former is capable of 2.5/3 kilowatts while the latter is capable of up to 5 kilowatts.

It has long been a goal of the station to achieve separate programming on their two shortwave channels. However economic conditions haven't improved to the point of establishing these two services. Today when heard these frequencies operate in parallel. The stations programming consists of Catholic religious features, education, agriculture, health, social service, music, and general entertainment features. They broadcast from 1130 - 1600 UTC and from 2130 - 0230 UTC on the previously mentioned frequencies of 4,835 kHz and 3,370 kHz. The WRTH lists both channels at 1 kilowatt.

Radio Tezulutlan is a good verifier. They issue an English language, full data card in response to reports. Address reception reports to Radio Tezulutlan, Apartado 19, Coban, Departamente de Alta Verapaz, Guatemala.

Radio K'ekchi' (TGVC)

Another recent addition to the Guatemalan shortwave scene is Radio K'ekchi' in Alta Verapaz. David Daniell, "Asesor de Comunicaciones", has received reception reports from all parts of the world including Japan, West Germany, Holland, England, Italy, Paraguay, Canada, Mexico and the USA. Letters are very much appreciated by the staff of the station which includes Don Gilberto Sun Xicol, Gerente; Don Felix Och, Announcer and Treasurer; and Don Miguel Coc Macz, Announcer. These letters provide the station staff with emotional support and stimulus in their work.

Radio K'ekchi' is supported by the gifts of various radio schools and offerings of 135 congregations that are part of a cooperative Association of Baptist churches. Programming is in Spanish and K'ekchi'. Their programs try to communicate Christian values and to help the poor and needy. Included in the program line up is a contemporary Christian music show, bible dramas, preaching and teaching the bible. There are over 365,000 K'ekchi' in Guatemala.

Radio K'ekchi' began shortwave broadcasting on 11 March 1988 with a 250 watt transmitter. Today, Radio K'ekchi' uses a 5,000 watt Gates BP-5 transmitter and a dipole antenna. Studio equipment consists of a Tascam M-208 mixer and Tascam 22-b cassette players. Nearly all the stations programs are recorded on cassettes for later broadcast. They are hoping to achieve further improvements in clarity and in coverage.

Radio K'ekchi' broadcasts on 4,845 kHz from 1000 - 1500 UTC and 2200 - 0300 UTC Monday through Saturday and on Sunday from 1200 - 1500 UTC and 2100 - 0200 UTC. As mentioned previously, broadcasts are bilingual and they are directed to the K'ekchi' population. Reception reports are verified with a form letter and a nice "Certificado de Sintonia". Reports should be addressed to David Daniell at Radio K'ekchi', Fray Bartolome de las Casas, 16015 Alta Verapaz, Guatemala.

Radio La Voz de Atitlan (TGDS)

This station targets its programs to one of the smaller Indian groups, the Tzuthils which are located in the region around Lake Atitlan. Therefore, approximately 90% of its broadcasts are in Tzutuhuil and 10% are in Spanish. Programs consist of education, agriculture, health, music (folklore, marimba and ranchera) and an "avisos" service.

Until 1979, La Voz de Atitlan broadcast with an old US Army 610A transmitter capable of only 300 watts output. In 1979 they obtained, and remodelled, a IED 1000AX transmitter which is used in conjunction with a 35 meter 1/2 wave dipole antenna. They have two studios. The newer one was equipped through a donation by Radio Netherlands. It consists of a LPB S-15A console mixer, two open Ampex ATR-700 tape decks, and a LPB S-7A disk player. The older studio contains only a home brew console mixer.

The station has had an interesting history after its founding on 25 August 1968 by a Catholic Mission. In 1980, the Director, Gaspar Culan Yataz, was kidnapped by right wing military personnel and later found dead. Shortly thereafter, the station was robbed and much of the broadcasting equipment was taken. In 1982 the Federacion Guatemalteca de Educacion Radiofonica assisted the station to resume broadcasts. Unfortunately, broadcast time was sharply reduced from its previous schedule. Recently, the station has expanded its broadcast day. The current schedule is from 1130 - 1430 UTC and 2030 - 0130 UTC on 2,390 kHz. This station is rarely reported and is probably the most difficult of all the Guatemalan stations to hear.

The station's economic condition is very poor. There is no funding from any of the Catholic organizations in the country. Station personnel raise the necessary funds to keep the station on the air. Because of the poor economic condition of the station, La Voz de Atitlan is a poor verifier. Interestingly, they do have their own QSL card. Try addressing Spanish language reception reports with return postage to La Voz de Atitlan, Santiago Atitlan, Departamente de Solola, Guatemala.

Radio Nacional de Guatemala ("La Voz de Guatemala", TGWA, TGWC)

La Voz de Guatemala is a government owned station with an obligation to play as much of the national marimba music as possible. Unfortunately, they are rarely heard on shortwave.

Currently, only the stations 640 kHz frequency is in use. The USA made CSI 10 kilowatt transmitter for 9,760 kHz using a half-wave dipole and the 10 kilowatt Collins transmitter, which replaced an RCA transmitter in 1977, on 6,180 kHz are inactive. The latter frequency was operating through 1980 on a regular basis but irregular thereafter.

Radio Nacional de Guatemala offers a variety of music programs featuring the national music - marimba. At three minutes to the hour, a block of information including government announcements, program guides, and station identification is broadcast. News is broadcast only four times a day. To avoid political friction with neighboring countries, the contents of these newscasts are limited.

The station broadcasts 24 hours per day Monday through Friday and from 1055 - 0605 UTC on Saturday and from 1150 - 0610 UTC on Sunday. If it resumes shortwave activity watch 6,180 kHz for the distinctive sounds of marimba music. The station can be reached at Radio Nacional de Guatemala, 5a. Avenida 13 - 18, Zona 1, Guatemala City, Guatemala or through the Guatemala DX Club, Apartado 583, Guatemala City, Guatemala.

HONDURAS

This small Central American country is best known for its production of bananas. It is a very poor country with limited transportation facilities. The country became the site of clashes between troops of the Nicaraguan Sandinista government and Nicaraguan rebels ("contras"). The contras used Honduras as a base to stage raids into Nicaragua. The country is bordered by Guatemala to its west, El Salvador and the Pacific Ocean to the south, the Caribbean Sea to the north and Nicaragua to the east.

BROADCASTING IN HONDURAS

Most of the radio and television stations in the country are privately owned. One in three Hondurans owns a radio. About 150 thousand television sets serve a population of over 5 million people. There is an extensive array of medium wave broadcast stations in the country. There once were many shortwave broadcasters from Honduras. Today, shortwave radio plays a minor role in communications. The country has six daily newspapers.

Radio Luz y Vida (HRCP)

Radio Luz y Vida, or Radio Light and Life in English, began broadcasting in 1979 on 1,600 kHz using a converted Johnson Valiant ham transmitter into a 1/8 wave antenna. The operating power was just 50 watts. This enabled the station to have a range of 31 kilometers. Shortwave operations commenced in December 1980 using a Gates BC - 400 transmitter with many modifications. Current operations include a Gates BC - 1J transmitter with a power of one kilowatt for the tropical band outlet on 3,250 kHz. HRCP utilizes a G5RB antenna with a gain of 4 to 5 db. The antenna is aimed north and south.

Radio Light and Life is a Christian Radio Broadcaster. It is owned and operated by the Emanuell Church in Honduras, and is supported by Evangelistic Faith Missions which is headquartered in Bedford, Indiana, USA. A majority of the stations equipment has been donated by radio stations in the USA and other organizations related to the broadcast industry.

The station operates from 1200 - 1500 UTC and from 2200 - 0400 UTC, daily, with mainly Spanish language religious programs. English language programming is carried on Mondays from 0300 UTC to sign off. Verie signer Donald Moore is the manager and broadcast engineer of HRPC. He is an active radio amateur with the call sign WA5FFK/HR5. The stations closing announcements are made by Mr. Moore. English language reception reports with return postage in the form of mint stamps can be sent to him at Radio Luz y Vida, Apartado 303, San Pedro Sula, Honduras.

Sani Radio (HRRI)

In July 1986, test transmissions were heard from a new shortwave station in the town of Puerto Lempira, Gracias a Dios. Established by the International Rescue Committee with assistence from the United States Agency for International Development, Sani Radio broadcasts on a frequency of 4,755 kHz with ten kilowatts.

The name Sani comes from the Miskito Indian word for a vine that is used as string which children use to make a "telephone" by connecting two coconut halves. The word Sani combined with Radio has evolved into a slang expression for oral communication.

The station's inaugural program on August 25, 1986 featured live broadcasts attended by more than 200 local persons, as well as guests from the Honduran Ministry of Education, Ministry of Interior and the United States AID Mission. HRRI's purpose is to provide Spanish, Miskito and Sumo language programs covering culture, education, entertainment, news and information, and public service broadcasts to the Miskito Indian population of the area. The station has nine employees doing the announcing, operating, writing and administrative work of the station. Various agreements expressly prohibit Sani Radio from transmitting partisan political or religious programs. Beginning in January 1987, Sani Radio was been operating under the administration of the Honduran agency AVANCE (Asociacion de Promocion y Desarolla Socio-Economico).

The transmitter is a Sintronic SI - A - 10 with ten kilowatts of power into a simple 30 meter long dipole antenna at a height of 15 meters. HRRI broadcasts from 1200 - 1600 UTC and from 2100 - 0200 UTC. The station was an enthusiastic verifier when they first came on the air. However, the initial enthusiasm died down somewhat after many of the North Americans that set up the station left. Generally, the station is a good verifier. Spanish language reception reports with return postage can be sent to the stations Director, Lic. Jacinto Molina Gonzalez. Address all correspondence and QSL requests to Sani Radio, AVANCE, Apartado Postal No. 2040, Tegucigalpa, DC, Honduras.

La Voz Evangelica (HRVC)

Founded in 1960 as a medium wave station, this religious broadcaster entered the shortwave spectrum in 1965. They have operated consistently on 4,820 kHz over the years and put out a good signal with their five kilowatt Mission Engineering transmitter using a 1/2 wave dipole antenna. The primary target area is all of Central America during the evenings. During daylight they can reach into southern Guatemala, El Salvador and Honduras. A medium wave repeater is scheduled to be installed in Santa Rosa de Copan in Western Honduras. Perhaps the elimination of shortwave broadcasting is comtempated.

The station has three main studios where their programs are produced. Most of the programs are prerecorded. However, one studio is used for live music performances that are broadcasted. The station offers a variety of educational, cultural, music and religious programs in Spanish. From time-to-time, the station has carried programs in Miskito for the local Indian population. These features were produced by La Voz de la Mosquitia in Puerto Lempira. In addition, there is an English language segment, which is produced in the United States, that is broadcast once a week. The Sunday evening local time, or Monday UTC, broadcast at 0300 - 0400 UTC is easily heard and makes reception report details a little easier to gather.

Over the years, La Voz Evangelica has been been a good verifier. Often it is the first Honduran verified by many DXers. Spanish language reception reports accompanied by return postage in the form of mint stamps should be addressed to the station at La Voz Evangelica, Apartado 145 - C, Tegucigalpa, D.C., Honduras.

La Voz de la Mosquitia (HRXK)

In 1981, a group of evangelical missionaries lead by Landon Wilkinson created the Global Outreach missionary station in northeast Honduras. It is a very small station with limited resources and is operated by announcer Leonardo Alvarez who also operates a craft shop in Puerto Lempira to support his family. Global Outreach, a Christian organization headquartered in Tupelo, Mississippi, wants to help people in developing countries help themselves.

The station operates on 4,910 kHz with just 300 - 500 watts of power. HRXX's basic schedule is from 1200 - 1500 UTC and from 0000 - 0300 UTC. The hours do vary. It broadcasts in three languages: Miskito, Spanish and English. The programs are cultural, educational, and religious. A recent newsletter mentioned that the station is doing the necessary paperwork for a permanent license. Apparently, they are operating under a provisional license.

Verifications are usually obtained through the organization's Executive Director Dr. Sammy Simpson in Tupelo. A prepared card is suggest since the station doesn't have its own QSL card. They do have a nice, small pennant. Address English language reports with mint stamps to Dr. Simpson at Global Outreach, La Voz de la Mosquita - HRXK, Box 1, Tupelo, MS 38802, USA. Spanish language reports can be sent direct to La Voz de la Mosquita - HRXK, Puerto Lempira, Honduras.

La Voz del Junco (HRMH5)

This station was founded in 1953 by Miguel Elias Hasbun Yacaman as a mediumwave and shortwave operation. The original shortwave transmitter was only 500 watts. At first it played all music. But shortly thereafter, as advertising revenue grew, it included news, information, radio novels and other cultural features. La Voz del Junco also carries religious programs on Sunday mornings.

In 1954, it obtained a Gates 750 watt shortwave transmitter. The old transmitter was kept for emergencies. With the new transmitter, the station began to receive reception reports from overseas. In 1980, the station ceased shortwave broadcasts as the transmitters useful life ended. By 1983, La Voz del Junco returned to shortwave with an 800 watt shortwave transmitter. The station was flooded with reception reports when they erected a new antenna while boosting power to one kilowatt. By 1985, the station has a five kilowatt shortwave transmitter in place. Its dipole antenna is located about a mile north of town.

La Voz del Junco operates on 6,075 kHz which, unfortunately, is a very crowded portion of the shortwave spectrum. Consequently, they are not frequently reported. During daylight operations the station covers all of Honduras and El Salvador and southern Guatemala. In the evening, interference from international broadcasters, who dominate the 49 meter band, hinders their coverage area. Besides Spanish, the station occasionally identifies in English and Japanese. The station operates from 1200 - 0430 UTC. Many of the news, commentary, radio plays, and musical programs are previously recorded in a highly used recording studio.

Despite its low commercial value, La Voz del Junco continues to operate on shortwave. The station is a good verifier. Owner and Gerente Miguel Elias Hasbun Yacaman enjoys the engineering aspects of shortwave transmissions. Also, he enjoys receiving listener reception reports. Address Spanish language reception reports with return postage in the form of mint stamps to La Voz del Junco, Frente al Parque central, Calle la Independencia, Santa Barbara, Honduras.

Radio Landia (HROX)

Radio Landia has been inactive through most of the 1980's. However, in late 1989 the station returned to the air for a brief period during the Honduran Presidential elections. Sporadic use of dormant shortwave facilities is not unusual in Honduras where the government is known to tell stations to use your license or lose it. Radio Landia apparently fired up their five kilowatt Collins transmitter with a 1/2 wave dipole antenna on 4,965 kHz to convince the government that they are still interested in shortwave. Unfortunately, the only way to hear Radio Landia is to be tuning the tropical bands when they make one of those infrequent appearances.

Founded in November 1968, Radio Landia operates from a very small studio in the town of Comayagua. It is connected to the transmitter site some 6 kilometers away by telephone line. Almost all of this commercial station's programming is music. Their schedule is 1000 - 0400 UTC Monday through Saturday and 1200 - 0100 UTC on Sunday.

This station is almost impossible to verify. Direct QSL's from the station are rare. The only known verifications were obtained by North American DXer Don Moore while travelling through the region and by Radio Luz Y Vida broadcaster Don Moore. Both obtained QSL's for other DXers too. If you do hear Radio Landia during one of its active periods try addressing Spanish language reports with mint stamps to Radio Landia, Calle Boulevard, Comayagua, Departamento de Comayagua, Honduras.

NICARAGUA

This country is the largest in Central America in area. It extends from the Pacific Ocean on the west to the Caribbean Sea to the east. It is bordered by Honduras to the north and Costa Rica to the south. About 60% of the country's almost 4 million people population live in the fertile regions on the Pacific coast where the capital city of Managua is located.

BROADCASTING IN NICARAGUA

The country is adequately covered through a network of domestic mediumwave stations controlled by the government. There are several privately owned radio stations. Shortwave coverage is limited. The government is represented on the international broadcast bands with its own station. Two privately owned stations cover sparsely populated regions of the country. All of the new commercial and religious broadcasting activity has been on medium wave and FM.

La Voz de Nicaragua

This is the only station operating in Central America with an "International Service" designed to reach an audience outside the region. La Voz de Nicaragua is the official government voice with an international service ("onda international").

The station uses a 50 kilowatt RCA transmitter that is fed through an FM link from studios in Managua. Most of the studio's RCA equipment predates the Sandinista take over, and replacement parts have been hard to come by because of economic sanctions against Nicaragua. This has forced the cut in the English service and curtailed broadcasting in general from this station.

La Voz de Nicaragua operates on 6,100 kHz from 1200 - 0100 UTC with Spanish programs. An English segment is listed in the WRTH from 0000 - 0100 UTC, excluding Mondays. Scheduling from La Voz de Nicaragua has been variable over the years with schedules lengthened and shortened without any notice. For a time in the early 1980's, this station verified listener reception reports with a friendly letter. However, times have changed and replies from the station are few. When it runs an English mailbag feature, letters and reception reports are read over the air. Obviously, reports are getting through but the stations resources are severely constrained. You can try sending Spanish language reception reports to the station's Director of "Onda Corta", Freddy Lopez Quiroz at La Voz de Nicaragua, Apartado 3170, Managua, Nicaragua.

Radio Zinica

During most of the 1970's, a private station called Radio Atlantico operated from the facilities of what we now know as Radio Zinica. The station's owner Raul Tinajero was purged by Sandinistas after they assumed control of Nicaragua. In December 1979, Radio Zinica took to the air playing Christmas carols with Spanish and English announcements.

Bluefields is a remote town along the Atlantic coast of Nicaragua. Like Costa Rica's Atlantic coast, this area was settled by black Jamacians. Shortwave is the only way to communicate effectively in this vast, swampy, and underdeveloped region. The station uses an Elcor transmitter capable of 5 kilowatts output. However, it rarely uses more than 2 kilowatts. Radio Zinica broadcasts on 6,120 kHz from 1100 - 0500 UTC. The station's transmitter was originally ordered by the former owner/operator. Mr. Tinajero had been using a 1000 watt Nicaraguan made transmitter for Radio Atlantico. A new Elcor transmitter was paid for and awaiting delivery to Bluefields when the Sandinistas came to power. The new "owners" inherited a new transmitter and some other new equipment.

Since Radio Japan began broadcasting from Sackville on 6,120 kHz, there have been few reports of Radio Zinica. Patience became the key to logging this station. On October 22, 1988, the shortwave transmitter was destroyed by Hurricane Joan. Perhaps the station will return to shortwave if replacement equipment can be obtained. Although a poor verifier over the years, if you should log this one try sending a report to the station's Director Arturo J. Valdez R. at Radio Zinica, Apartado 25, Bluefields, Nicaragua.

Radio Sandino

The station was founded in 1977 as the Voice of the Sandinista National Liberation Front (FSLN). It was the radio voice of the FSLN's effort to overthrow the Somoza government established in Nicaragua. Although claiming a Nicaraguan location, Radio Sandino was reported to be broadcasting in Costa Rica. When Somoza left Nicaragua in July 1979, the station held an on the air celebration. Shortly after the celebration, the station's name was given to a medium wave outlet in Managua. A shortwave outlet was established in the 49 meter band.

Radio Sandino was a typical clandestine operation in its eariy years. They broadcast advisories to the foreign community to get out of the country. The usual guerilla fare of explaining the use of M - 1 rifles, the preparation and use of Molotov cocktails and messages on how to execute members of the government were issued. After becoming a legitimate station, Radio Sandino's programming switched to news and information, music, radio dramas and sports.

There have been very few reports of Radio Sandino in recent years. The station has been reported as inactive due to the unavailablity of spare parts for the shortwave transmitter. Its 50 kilowatt medium wave channel on 750 kHz is well heard throughout Central America thereby making the reactivation of the shortwave outlet unnecessary. However, watch 6,200 kHz between 1100 - 0130 UTC for a possible return to shortwave for Radio Sandino. Recently, Martha Lorena Castillo, Assistant Direccion General has responded to requests for verifications. Address Spanish

language reports with return postage to Radio Sandino, Audio de la Revolucion, Paseo Tiscapa, Managua, Nicaragua.

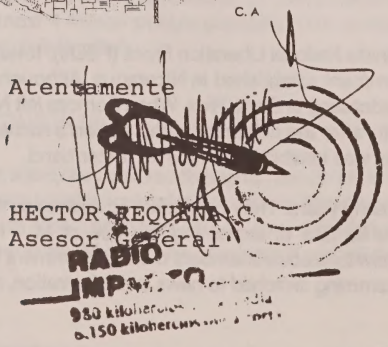
SUMMARY

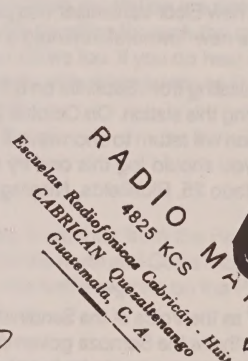
The six Central American shortwave countries represented on shortwave provide ample opportunity for the serious DXer to fatten his shortwave stations heard and verified totals. Overall, the shortwave stations of this region are better than average verifiers.

Costa Rica, Guatemala and Honduras provide the most opportunities and challenges. There are no international government voices presently operating from this region. Recent additions have been mainly religious broadcasters.

Costa Rica fills the airwaves with a blend of commercial, religious, quasi-clandestine and educational broadcasters which provides a diverse assortment of programming from this country. Guatemala offers a number of interesting and exotic shortwave stations to challenge any DXers ability. The diverse cultural backgrounds of the various Mayan Indian descendants, the wide range of musical styles, and the many Indian languages used by Guatemalas shortwave broadcasters make this country an interesting and challenging country to DX. Honduras is past its peak for shortwave activity. However, from time-to-time a familiar voice reappears which stirs some excitement in the DX community.

Future prospects for more shortwave additions are mixed. Radio Exterior de Espana intends to build a relay facility in Costa Rica. Guatemala will probably see more religious stations setting up shop in the untouched remote regions of the country. Perhaps Nicaragua offers the most opportunity for change as a consequence of the elections held earlier this year. All in all, the future for shortwave broadcasting in Central America reflects the trends of this region over the years - uncertain! In any case, enjoy the interesting, diverse blends of music and culture that Central America has to offer through shortwave radio.





Asociación La Voz de Atitlán
Escuela Radiofónica
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Depto. Sololá
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RADIO "TEZULUTLAN"
T. G. T. Z.
APARTADO POSTAL No. 19, COBAN, ALTA VERAPAZ
GUATEMALA, CENTRO AMERICA
4,835 Khz. 3,370 Khz.
CULTURA Y EDUCACION
160[illegible]

SHORTWAVE RADIO FROM THE AFRICAN SAHARA AND SAHEL

Harold Cones

THE AFRICAN SAHARA

A look at a map of the Sahara region of northern Africa is deceiving. The map tells little about the true events transpiring there, the cryptic nature of the area's history, and, other than the straight borders drawn by a politician's pen, the effects of years of colonial rule.

To many, the Sahara is shrouded in mystery, a mystery that is fueled by lack of knowledge. To better appreciate how shortwave is a reflection of the region and its peoples, it is necessary to first look at the Sahara itself and then discuss the Sahel, the sub-Saharan area now undergoing rapid desertification. All of northern Africa is an area in considerable turmoil and one that offers much in variety listening for the shortwave hobbyist.

The Arab word for desert is *sahara*, and The Sahara Desert, the largest in the world, easily defines the word. The Sahara covers all of northern Africa (with the exception of a thin line along the Mediterranean and the Nile River) and includes areas once known as the Barbary Coast and Afrique Occidentale Francaise. New maps show the countries of the Sahara as Mauritania, Tunisia, Algeria. Western Sahara, Egypt, Libya, Morocco, and portions of Chad, Niger, and Mali (although the rapidly expanding desert makes placement of countries into either Sahara or Sahel difficult). The Sahara is much more than the shifting sands of late night French Foreign Legion movies; it is an area of great geographical diversity, haunting beauty, and a surprising source of information about prehistoric human life.

The backbone of the Sahara is the Ahaggar, a volcanic mountain chain with peaks of over 9,000 feet. To the south lie the Adrar n Iforas and Air mountain chains, stretching toward Niger and tropical Africa. To the northeast are the table mountains of the Tassili n Ajjer, which divides the Saharan Desert from the Libyan Desert in Egypt. The Tibisti Mountains extend toward Chad, Central Africa, and the Sudan. Surrounding the mountains are huge plains of multicolored outwash gravel, called *regs* by the nomads. Over half of the Sahara is covered by regs, the largest, the Libian Reg, covering 340 square miles. The regs dominate the desert and give it the appearance of lifelessness. Sand dunes (*ergs* in Arabic) border all sides of the Sahara and cover about 25% of its surface.

The Sahara is found in the global desert belt (between 15° N and 35° N) that is created when warm air rises from the equator, carrying moisture with it. The denuding of the Sahara region many thousands of years ago, mostly for firewood, also causes air masses to warm and rise over the desert, thus not releasing moisture. Today, much of the Sahara receives less than four inches of rain per year and there are documented cases of some areas receiving no rain for as long as 17 years.

The climate of the Sahara is harsh, not only because of the lack of moisture, but also because of the extremes of heat and cold. In the night, the desert cools very rapidly and frost is not uncommon in some areas, particularly in the mountains of the northern ergs; snow has been known to fall in the higher elevations of the Ahaggar. The dominant rock and sand composition of the Sahara gets very hot during the day. Temperatures as high as 122° F are not uncommon, and surface sand temperatures have been measured at 175° F. The reflected heat from these surfaces tends to dry the air still further.

As a biological environment, the combination of temperature variation and

great heat render the Sahara as inhospitable as the polar regions. The few plants and animals found there have had to make many adaptations. When rain briefly falls in the Sahara, a wild profusion of flowering occurs. Sand dunes may assume a green appearance as grasses briefly emerge; in the valley between the dunes, wild flowers may be found.

The geological background of the desert can be read in the mountains and water cut valleys. The main Saharan plateau, composed of sandstone, is about 500 million years old. Even to the casual observer, dry river beds and canyons (and the presence of limestones and sandstones) suggest a water-worked area. The Saharan region has been covered by seas, tropical rain forests, and savannahs several times in its geological history.

The Ahaggar Mountains were formed when plate tectonics caused a gradual upheaval of the earth, allowing weaknesses through which volcanoes erupted. Geologists have determined that during the Carboniferous period, about 250 million years ago, a vast sea flooded the desert. The sea gradually receded and was replaced by marshes, lakes, and some dry land. Dinosaur remains suggest that there were tropical forests and a large variety of both plant and animal life during this time. By the Cretaceous, about 130 million years ago, the sea returned, this time in the north and south, leaving the central area dry. The seas withdrew, and savannahs again appeared. During times when vegetation covered the area, a series of wet and dry periods resulted in an enlarging and receding of lake systems. During one of these dry periods, the desert was much larger than its present size, extending more than 300 miles into Central Africa.

Since none of the ancient Saharan rivers had outlets to the ocean, the erosion products they carried from the mountain spine flowed into closed basins, depositing the erosional material as gravel plains, or regs. During dry periods, the smaller sized particles were carried by wind to form ergs (sand dunes) at the edge of the desert. Wind has shaped the desert in other ways, eroding hollows and grooves and wearing down projecting outcrops. One of the more unusual formations of the desert is a *yardang*, a fin-shaped aerodynamic structure which results from wind erosion on a projecting rock outcrop. Yardangs may be 600' high and as long as a half a mile.

In the Western Sahara, interesting geological formations called *dhars* are found. Dhars are sandstone cliffs formed when tectonic changes caused sedimentary sandstone to break and tilt, forming cliffs several hundred feet high which may extend for hundreds of miles. Dhars are important navigational markers in the desert, because they represent a known elevation point in a greatly flattened area.

Early man's role in the Sahara is poorly understood. The earliest signs of human life are stone tools that date back several hundred thousand years. Much has been learned about human occupation of the desert region, however, by studying the desert paintings, or pictographs, found in some stony areas. The pictures show that early people in the Sahara were hunters who camped near lakes. Later pictures show nomadic herdsmen with cattle. The pictographs show that military and commercial routes were open across the Sahara as early as 1000 BC. Later paintings show, as horses are replaced by camels, the effects of increasing dryness about the time of the Roman occupation, in the second century A.D. By the fourth century, most of the nomads of the desert used camels. Camels, which graze closer than cattle, most likely aided the expanding of the Sahara by eating the vegetation that anchored the sand in place.

During periods of mild climate, vegetation typical of the shores of the Mediterranean spread through the Sahara. By about 4000 B.C., such typical Mediterranean trees as maple, ash, walnut and lime were common in the mountains. There are still remnants of this flora in some areas of the desert. Laperrine's olive, although now unable to reproduce, is found above 5000' elevation, where its often twisted trunks can stretch as high as 30-40'. A typical Mediterranean cypress, the duprez cypress, is found in rocky regions where moisture is available. They also have lost their ability to reproduce in the Sahara, however, their seeds are viable if planted in the deep soils near the Mediterranean.

The history of the native peoples in the years after the desert paintings and

prior to the arrival of the first conquerors is practically nonexistent, although historians have pieced together a story of warring tribes, famine, and disease. The native population of all Africa was highly varied and territorial; territorial conflicts appear to have been most common. The variability of the native Africans is without question. There are numerous unrelated linguistic stocks whose evolution puzzles modern linguists but attests to the relative isolation of the "tribes" that inhabited the continent before the arrival of the Europeans. Over five dozen dialects are found in the region of the Sahara alone.

The earliest known identifiable native inhabitants of northern Africa were the Berbers, a diverse people united only by a common language. Current theory suggests their origin to be in the eastern Mediterranean, however their rapid assumption of the culture of their many captors has made their early roots difficult to untangle.

By the 12th century B.C.(some say as early as the 16th century), the Phoenicians established the first settlement of outsiders in northern Africa and slowly assimilated Numidia, as the Berber kingdom was called. The most famous Phoenician settlement was Carthage, founded in 814 B.C., near what is now Tunis. Its strategic location made it the guardian of the Mediterranean for nearly 600 years. Carthage is thought to have been home to 700,000 people at the height of its wealth and power and formed the anchor for a huge trading empire. Phoenician culture did not spread through the rest of Africa, however, since the Phoenicians were chiefly traders and not explorers or conquerors.

The Greeks began to settle portions of northern Africa about 600 B.C.. A long series of wars erupted between the Greeks and the Phoenicians, wars that spread throughout the Mediterranean. Greek influence in Africa was minimal, and with a series of Roman invasions between 264 and 146 B.C., the Punic Wars, both Greek and Phoenician influences in Africa disappeared. The Roman impact in northern Africa was sizable and long lasting. Under Roman rule, agriculture, communication and quality of life were vastly improved. The Vandals invaded Roman Africa from Spain in 428, ruling the area for a century until they were displaced by the Byzantines, thus returning Roman rule to northern Africa.

Successive waves of Arabs from the east, primarly Egypt, swept through northern Africa in the latter half of the 7th century, bringing the Muslim religion and the Arabic language. Their numbers were initially small and it was nearly a century before most of northern Africa had become Muslim. The earliest center for Muslim activity in northern Africa was Fez (Fes), in present day Morocco. Many independent Muslim states developed and were in constant war with each other; rule changed rapidly over northern Africa. In spite of the Muslim influence and the constant destruction of war, Roman culture died very slowly. Around 750, Moors, people of mixed Arab and Berber descent, invaded Spain, which led ultimately to Spanish retaliation by taking portions of Moorish northern Africa. The Moors regained their territory by 1578 and northern Africa, for the most part, remained peaceful until it became the center of European imperialist rivalries in the late 19th century.

The Turks arrived in northern Africa in 1514, seeking pirate bases. They formed a treaty with the Berbers and took charge of a sizable area. Their interest was solely in piracy and they did little to subdue the subjects under their control, thus causing little local disturbance. Their pirate activity, however, drew European attention to the Barbary Coast and eventual retaliation.

ALGERIA

Although debatable as to exactly when French involvement began in African affairs, it is known that the French easily captured and occupied Algiers in 1830. The government of Algiers was in total collapse and the French used the excuse that Algiers was the center of Barbary piracy and needed to be subdued. By 1848, the conquering of all Algeria was complete and it was made part of France. Independence, after a long history of political unrest and guerrilla movements, came in 1962. The official language of Algeria is Arabic, although French is universally used.

Radiodiffusion-Television Algerienne can be best heard broadcasting in English on 9535 KHz between 1900 and 2000 UTC with news and classical music. This broadcast comes from the 100 Kw transmitter at Bouchaoui. RTV Algerienne verifies with an attractive QSL card, but verification is spotty.

TUNISIA

The French occupied Tunisia in 1881 as an extension of the protection to shipping that they had started with Algeria. It became a French protectorate and remained so until 1957. As with Algeria, the official language is Arabic, with French as the universal second language.

Radiodiffusion-Television Tunisienne is often an easy catch on 12005 KHz at the 0430 UTC sign-on in Arabic. Broadcasting from Sfax with 100Kw, RTV Tunisienne provides a steady diet of middle eastern music. Verification is rare, but short busts of activity occur occasionally. Verification is by letter.

MOROCCO

Morocco, once the home of the vicious Sale pirates, found itself in numerous clashes with the French and Spanish. Finding a weakened Moroccan government, France and Spain divided the country into French and Spanish protectorates in 1912. In 1923 the port of Tangier was declared an international zone, free of the military and permanently neutral. Spain and France recognized the independence of Morocco in 1956. Later the same year, the international zone of Tangier was abolished. Co-major languages of Morocco are Arabic, French, and Spanish.

Morocco has occupied the northern portion of the country of Western Sahara since 1975. Western Sahara, like Morocco, was claimed by the Spanish and was a Spanish colony until 1960, when it was declared a Spanish province. In 1973, the indigenous people of the area, the Sahrawis, began a liberation movement. Morocco, with historical claims to the area as part of "Greater Morocco", capitalized on the political unrest, and in 1975 invaded Western Sahara with 350,000 troops. In addition to territory, Morocco was interested in Western Sahara's deposits of phosphate rock, the largest in the world. The acquisition of Western Sahara's phosphate, when coupled with the sizable deposits in Morocco, gave Morocco the dominant position in the world phosphate market. In 1976, Spain withdrew from the colony, agreeing that it should be divided between Morocco (the northern portion) and Mauritania. The Sahrawis maintained their claims to Western Sahara, although Morocco continues to invest in the northern portion. A referendum may be held on the future of the Western Sahara, although with a large nomadic population, it would be difficult to conduct. Co-major languages of Western Sahara are Arabic and Spanish. Additionally, Berber is spoken by much of the population.

The national shortwave outlet of Morocco is Radiodiffusion-Television Marocaine, which operates a 100kW transmitter from the seaport city of Tangier, at the Straits of Gibralter. When conditions are favorable, its Arabic broadcast on 15330 KHz is an easy catch around 2000 UTC. Varification of the international service is by QSL card and fairly reliable. A recent shortwave outlet is Radio Mediterranee International, which broadcasts on 9575 Khz from Nador (once part of Spanish Morocco). Reception is a sometimes affair but is best around 2000 UTC. Radio Mediterranee rarely verifies, but when it does it is by letter. A third choice in Morocco is the VOA relay site in Tangier, but your knowledge of Moroccan culture will not be enhanced by this station since it serves as a standard relay of Washington-originated VOA programs. Varification via Washington is quick, with a standard colorful VOA QSL card.

MAURITANIA

Mauritania, originally a Berber kingdom, became a French protectorate in 1903 and a colony in 1920. Like other former French colonies, Mauritania received

independence in 1960. An Army coup occurred in 1978, and a succession of military leaders has followed since. A causative agent of the coup was the problems being encountered by the Mauritanian government in trying to enforce its claim on Western Sahara. Following the coup, the military government signed a peace treaty with the Polisario insurgents in 1979. Although two thirds of the country is desert, copper and iron ore deposits make it one of the Sahara's richest. Severe draught has virtually eliminated the nation's animals and the once dominant nomadic population has now settled near population centers. Arabic and French are the official languages of this Muslim country.

Office de Radiodiffusion-Television de Mauritaine broadcasts chiefly in Arabic and is a good provider of middle-eastern music. The 100kw transmitter is located in the capitol city of Noukchott, a city built in the 1950s. Noukchott is on the Atlantic coast and is a city of attractive flat-roofed houses, wide sandy streets and beautiful mosques. It may be enlarged during drought times by a huge tent city filled with over 300,000 refugees from the rural areas. ORTM can be best heard on 4845 KHz near its 2400 UTC sign-off. Its QSL record has been spotty until recently; it is currently a good verifier.

LIBYA

Some of the finest Roman ruins are in Libya, but the Romans were not the first to occupy this arid land. There is evidence of earlier Egyptian and Greek settlements, as well as those of the Phoenicians and Carthaginians. Arab invaders brought Islam and converted the native Berbers in the seventh century. Libya was claimed as part of the Turkish Empire from the 16thcentury until 1911, when hostilities broke out between Turkey and Italy and Italian troops entered Libya. Tripoli was occupied in 1912. Tripoli was the scene of much desert fighting during World War II and fell to the British Eighth Army in 1943. The U.N. voted for Libya to become independent in 1952 and the discovery of oil in the Libyan Desert provided a monetary base for the new country (today oil has provided Libyans the highest income per head on the African continent). A bloodless coup occurred in 1969, and under military rule, the name of the country was changed to the Socialist People's Libyan Abab Jamahiriya. Military leaders have made modern day Libya the seat of international terrorism. In recent years, Libya has backed one of her territorial claims by invading Chad. The country has also sent troops to the Sudan and Uganda and has provided military aid to anti-government forces in Lebanon, Ethiopia, and Northern Ireland. In addition to oil, the economic base of the country is supported by sheep, hides, skins, dates and olives. Arabic is the official language.

Libyan Jamahiriya Broadcasting operates its external service from a 500kw transmitter in the capitol city of Tripoli, on the Mediterranean near the Tunisian border. The interior portions of Tripoli are old, with narrow, winding market-lined streets. Along the seafront, large buildings and houses are set along eucalyptus-lined avenues. A good time to hear this station in English is between 2330 and 0100 UTC on 6155 khz. The English broadcast features middle eastern music and political features. Although once a very poor verifier, Radio Jamahiriya currently responds with a colorful QSL via its Malta address.

EGYPT

Egypt is the site of one of the world's oldest civilizations, with a recorded history of 5,000 years. The strategic location of Egypt, between Africa and Asia and with access to the Mediterranean and the Red Sea, has made it a tempting prize to invaders for centuries. First the Persians, then the Greeks, Romans and Arabs. In 1517, Egypt became part of the Turkish Ottoman Empire and in 1798 Napoleon arrived. The French built the Suez Canal between 1854 and 1869 and British troops occupied Egypt in 1882. Egypt was granted independence in 1922 but British troops remaind to guard the canal. Freedom was finally won in 1953. Egypt is involved in a variety of projects to bring fertility to the desert land, among them the Aswan High Dam and the New Valley Project, a series of deep wells. Reclaimed land, as well as the Nile bottom land, provide rich crops of rice, maize, wheat, vegetables and fruit, as well

as pasture for cattle, buffaloes, goats and camels. Cotton and dates form the main cash crop. The official language of Egypt is Arabic.

Radio Cairo has been a middle eastern music staple for many years. Broadcasting to North America from a 250kw transmitter in Abis, this station is best heard in English between 0200 and 0330 UTC on 9475 or 9675 Khz. Verification, which is by QSL card, has always been spotty.

THE AFRICAN SAHEL

The Sahel, presently encompassing about 20% of the African land mass, derives its name from the Arabic word for "border," since it provides a belt between the Sahara Desert and the tropical rain forests. The Sahel is an area of rapid desertification and oneinto which the Sahara is expanding. Listing countries that comprise the Sahel has been complicated by a series of droughts that have occurred through central Africa since the early 1970s, creating drought stricken countries, but countries not considered part of the Sahel. As an example of the problem, a 1974 publication lists 5 countries comprising the Sahel. A 1987 publication lists 11 countries, and a 1990 publication lists 17 countries. This rapid increase is due to the inclusion of all drought stricken countries on the list, rather than just those into which the Sahara Desert is expanding. It is generally agreed that presently 6 countries are found in the Sahel. These countries are Senagal, Burkina-Faso, Chad, Niger, Sudan, and Mali. As droughts continue in Africa, more countries will no doubt be added; some references already include Ethiopia.

The Sahel has been highly visible for the last ten years as numerous aid programs have been established to render assistance to drought victims. In actuality, the drought only brought to the surface a problem which had been festering in the region since the turn of the century. The essence of the tragedy in the Sahel is that the famine was not caused by a brief period of dry weather or drought, but was caused instead by the presence of man and recent events in African history.

The land of the Sahel was once semi-desert and had four months of rainfall a year. The grasses were sufficient to support the herds of cattle tended by the nomads. Millet and sorgum were grown on stable farms in the southern regions of the Sahel. By 1968, just prior to the drought, the savannah ecology of the Sahel was supporting 24 million people and approximately the same number of cattle, roughly a third more than had been present 40 years

earlier. The actual agent of the collapse of the Sahel was the 1968 drought, the third of such severity that had occurred in the century. By 1972, the fifth year of the drought, people and cattle were beginning to die. Lake Chad receded 15 miles from its shore line and fractured into three smaller lakes. The ancient cultural center of Timbuktu, a port city fed by an inland Nigerian river, was completely cut off and today lies surrounded by desert. The nomads were forced to sell their only means of subsistence, the cattle, and with no income, were forced to live in refugee camps or tent cities on the edges of cities.

The Sahel was once one of the most important areas of Africa. In the middle ages, it was the home of the legendary trading empires of Ghana, Mali, and Songhai. Success of the Sahelian way of life resulted from an excellent adaptation to the semi-desert environment. To the casual observer, the life of the nomad appears undirected; in actuality it is very well directed. The dry season found the nomads in the far south of the region, where they had a form of symbiotic relationship with the sedentary farmers. The nomad's cattle would graze the stubble left in the agricultural fields and would in turn deposit manure to enrich the field. The nomads would also receive millet from the farmers in exchange for the manure. When the rains came and the grass began to grow, the nomads would move northward, following the greening grass. After grazing in the north, the herds would return to the south, grazing on the grass that had grown in the southern rainy season. The traditional migration routes and the amount of time a herd of any given size might spend at a particular area, were governed by rules worked out by tribal chiefs. In this way, overpasturage was avoided and the nomads had control over the environment that was so important to their well being.

The settled part of the population, the farmers, had an equally compatable understanding of their environment. They had learned to let the land lay fallow for long periods, in some cases, up to 20 years, before recropping, and they grew a variety of crops adapted to different growing seasons and situations.

When much of the Sahel came under French rule in the late 19th century, this delicate system was upset. The French colonial empire was interested in developing wealth in the Sahel and changed the farmers cropping practices from sorghum and millet to cash crops, such as peanuts and cotton. The French further divided the Sahel into separate states with definite boundaries. In many cases, nomadic tribes were prevented from crossing these boundaries, thus limiting their freedom of movement and upsetting the old tribal customs allowing for the exchange of farmer and pasture nomad.

Ironically, probably the most important impact on the Sahel was the introduction of European medicine. The introduction of good health practices altered a slow growth population (about 2.5% per year) into one of the highest population growth rates in the world. Veterinary medicine allowed an equally unchecked population increase in cattle, and a very large population of cattle and people quickly developed. Since a nomad's worth was measured in the number of cattle he possessed, herds increased dramatically in size in a very short period of time. As almost a cruel joke, Mother Nature provided seven years of unusually heavy rains which supported grass in higher concentration than in normal periods. Soon, as the rains faded, the herders began to overtax the pastures, and the farmers began to do likewise as the very best lands were taken out of food production and planted in cash crops. The usual process of allowing the land to lie fallow for a long period of time became a process of allowing the land to lay fallow for only one year. Fertility began to decline, slowly at first, and then dramatically. The poor crops left the soil barren, which was easily picked up by wind and eroded by rain. Very rapidly, the once semi-lush regions of the Sahel began to desertify and lack of rainfall accelerated the process.

Desertification was compounded further by the introduction of deep wells, known as bore holes, installed by well-intentioned individuals and governments. A vast reservoir of water lies a thousand feet under the Sahel, and as water became scarce and the land devastated, more and more bore holes were installed to nourish pasture land and provide water for cattle. A major problem occurred as enormous herds of cattle converged on the bore holes, sometimes from hundreds of miles away, destroying the land around the bore hole for as great as 50 square miles. The overgrazing of the Sahel was a

consequence of having too many cattle with no place to go. The ultimate desertification came as farmers destroyed their land, leaving it to be blown by the wind. The breakdown between the nomads and the farmers became complete.

Desertification was additionally hastened by the cutting of firewood. More than 50% of all of the wood cut in the world is used as firewood and the Sahel is no exception. The removal of trees exposed more soil to air and water erosion. Slash and burn agriculture, which was practiced in part of the Sahel, further destroyed the land. As firewood became scarce, the nomads burned dried cow dung. Dung used for burning was no longer available to release nutrients to the soil, and the soil became poorer.

Thus when the drought did come, conditions had already been set in motion for massive famine. It is in the context of an ecologically devastated area, that we look at the political history and the shortwave stations that operate from the Sahel.

CHAD

Chad, a former French colony, was a territory in French Equatorial Africa (Afrique Equatorial Francaise) until 1960, when it became an independent republic (other countries carved from French Equatorial Africa are Central African Republic, Congo Republic and the Gabon Republic). Coastal areas of FEA were discovered by the Portuguese in the 15th century and used as slave ports. Between 1839 and 1843, Capt. L.E. Boret-Williaumez captured the Gabon estuary for France, where a refuge for free slaves was founded and called Libreville. H.M. Stanley discovered the course of the Congo River between 1874 and 1877, whereupon a French explorer, Pierre Savorgnan de Brazza, made treaties with the inland tribes, putting them under French rule. Very heavy wars between France and local tribes in the Chad region resulted in subjugation of the natives in 1900. In 1910, all colonies were federated into French Equatorial Africa. This area supported Free France in WWII, and in 1946, all FEA residents were made French citizens. In 1960 each state became independent.

Radiodiffusion Nationale Tchadienne, broadcasting with 100kw from the capitol city of N' Djamena, is the national station of Chad. Try for this one on 4905 KHz at its 0430 UTC sign-on. Although often a difficult catch due to propagation or jamming, it is worth the try since some of the best "highlife" music to be found comes from this station. For the Dxer, Radio Moundou, transmitting from the central city of Moundou with 1kw, is a very nice catch. Try 5286 KHz at the 0457 UTC sign-on. Both stations are spotty verifiers, but will verify with letters at times.

FORMER FRENCH WEST AFRICA

French West Africa (Afrique Occidentale Francaise) was until 1959 a federation uniting eight territories. The territories were easily broken into two distinct geographical groups. The first group included Senegal, Mauritania, French Sudan, Upper Volta, and Niger, all in the northern tropical zone--Senegal, Mali (old French Sudan), Burkina-Faso (old Upper Volta) and Niger are countries of the Sahel; Mauritania was discussed with the Sahara. This area has a dry climate with a single rainy season and grows baobob, tall grasses, millet, peanuts, and humped cattle. The inhabitants are Sudanese Blacks who settled the land and converted to Islam early. A little further north in this area the savannah gives way to the Sahara desert which is populated by nomadic Moors and Tuaregs. The second group comprised the Republic of Guinea, the Ivory Coast, and Benin (former Dahomey), which are in the northern equatorial zone with two rainy seasons.

The French were long established on the west coast of Africa where they engaged in gum and slave trading; the chief gum factory was in Senegal. Submission of the inland areas started in 1854 when French explorers subdued much of Senegal and Niger. From these outposts the French expanded their influence outward to include all of the area that came to be known as French West Africa in 1895. The area supported Free France in WWII, and in 1946 the colonies were transformed into territories of the French Republic and the inhabitants made French citizens. In 1958 territories became autonomous

states, and in 1959 French West Africa ceased to exist. By 1969, all the former colonies had achieved independence.

SENEGAL

With its 100kw transmitter operating intermittently from Dakar, the national station of Senegal is the Office du Radiodiffusion-Television du Senegal (old-timers will remember "Radio Dakar"). When in operation, it is best heard with French and Arabic programming on 4890 KHz between 2300 and 2400 UTC. QSLs are spotty, but a very nice QSL is issued.

MALI

Mali is represented on shortwave by Radiodiffusion Television du Mali, broadcasting from Bamako with either 50 or 100kw. U.S. listeners have the best chance to hear this station at its 0555 UTC sign-on on 4783v, 4835v and 7285 KHz. RTV Mali plays excellent "highlife" music and when the propagation is good, makes for some of the best African music on shortwave. Verification is irregular.

BURKINA-FASO

Upper Volta is now Burkina-Faso and its shortwave outlet, Radiodiffusion-Television Burkina, broadcasts from Ouagadougou with 50kw. It is usually best heard between 2300 and 2400 UTC, or at its 0530 UTC sign-on, on 4815 KHz. It programs chiefly in French and some vernaculars and is a good verifier; its QSL often arrives with beautiful stamps attached.

NIGER

La Voix du Sahel, the international service of the Office de Radiodiffusion-Television du Niger, is a spotty catch (and verifier) on 5020 KHz around its 0530 UTC sign-on. It provides a different style of "highlife" music from the other Africans and is worth the listening when the reception is good. Programming is chiefly in French and African dialects from the 100Kw station.

SUDAN

Sudan is the largest country in Africa and one that has received double problems from the drought: loss of its own food production, plus a massive influx of refugees fleeing from war and famine in Ethiopia and Chad. Occupying much of the upper Nile basin, Sudan is a melting pot of races. In ancient times, two civilizations flourished in Sudan: Nubia and Kush. The country was converted to Christianity in the 6th century and to Mohammedism in the 14th century. Sudan was conquered by Egypt in 1820 and managed to expel the Egyptians in 1898, only to be reconquered in 1899. Between 1899 and 1955, the area was known as the Anglo-Egyptian Sudan and achieved its independence in 1956. Since 1956, the rapidly changing government has been stressed by problems associated with famine and civil war. Sudan is today the world's greatest source of gum arabic, used in medicines and inks, and also produces sesame, groundnuts, cotton, sugar and textiles.

An often rare piece of DX is offered by Sudan via the 10kw Sudan National Broadcasting Corporation outlet on 9540 Khz from Soba (the once often reported tropical band frequency of 5039 KHz has been inactive for several years). Programming is chiefly in Arabic and the best time to log this difficult-to-hear station is at its 1100 UTC sign on, although its 10kw signal often does not make it to the U.S. The station occasionally verifies with a letter.

The regions of the Sahara and Sahel are undergoing massive changes as the droughts continue. The Sahara continues its expansion into the Sahel, and more countries are being added to the Sahel as time passes. The areas are also plagued by political unrest and a generally decreasing annual per capata

income as population numbers continue to outgrow the amount of available food. Change is inevitable; listen to the Sahara and Sahel on shortwave and witness the change.

The following table is not intended to be an all inclusive listing of shortwave stations operating in the African Sahara and Sahel, but rather a "best bet" listing to enable gathering of information from the area. Since many of the stations are in the tropical bands, winter reception is best. Listeners on the east coast of North American typically find good reception conditions from local sunset until station sign-off; those in central North America should find reception best near many station's 2400 sign-off time.

SHORTWAVE STATIONS OF THE SAHARA

	X-mitter location	Freq	S-on	S-off	Lang
ALGERIA					
RTV Algerienne	Bouchaoui	7145	1500	0005	A
		9535	0600	0005	F
		15160	0700	1800	F
		17745	0800	1500	F
EGYPT					
Egyptian RTV Union	Abis	9475	0200	0330	E
		9675	0200	0330	E
LIBYA					
Libyan Jamahiryi	Tripoli	6155	2330	0100	E
		15450	1315	1745	E
MAURITANIA					
ORTM	Nouakchott	4845	0630	2400	A/F
MOROCCO					
RTV Marocaine	Tangier	15330	0945	2100	A/E
R. Mediterranee Int	Nador	9575	0800	2100	F/A
VOA	Tangier	9760	1830	2200	E
		15205	1700	2200	E
TUNESIA					
RTV Tunisienne	Sfax	7475	1800	2300	A
		12005	0430	2300	A

SHORTWAVE STATIONS OF THE SAHEL

BURKINA-FASO					
RTV Burkina	Ouagadougou	4815	0530	2400	F
CHAD					
RDF Nationale	N'Djamena	4905	0430	2200	F
R. Mondou	Moundou	5286	0457	1829	F/A
MALI					
RTV Mali	Bamako	4783	0555	2400	F
		4835	0555	2400	F
		7285	0555	2400	F
NIGER					
L Voix du Sahel	Niamey	5020	0530	2200	F
SENEGAL					
ORTV du Senegal	Dakar	4890	0600	2400	F
		7170	0600	2400	F
SUDAN					
Sudan NBC	Sobo	9540	1100	1459	A

LE CHEF STATION RADIO MOUNDOU
HUNA NOUAKCHOTT!!
ICI NOUAKCHOTT
RADIO MEDITERRANEE INTERNATIONALE (G. O. 1734 MI
REPUBLIQUE DE HAUTE-VOLTA
Unité - Travail - Justice
MINISTERE DE L'INFORMATION
RADIODIFFUSION TELEVISION VOLTAIQUE
BP 7029 - Ouagadougou -
YOUR QSL CARD
RADIO JAMAHIR
VOICE OF THE
SOCIALIST PEOPLE'S LIBYAN ARAB
BROADCASTING DAILY IN ENGLISH ON 11816 KHZ
SHORT WAVE FROM 22.30 - 24.00 HRS.
HEAD OFFICE
RADIO JAMAHIRIYA
P.O. BOX 333
TRIPOLI - S.P.L.A.J.
ICI NIAMEY
RADIODIFFUSION DU NIGER
REPUBLIQUE TUNISIENNE
MINISTERE DES COMMUNICATIONS
TELEDIFFUSION TUNISIENNE
4, Rue de Kenya - 1002 Tunis
Tél. 283.177 - Tlx 13426
N° 0734 TDT/AC
RADIO
الاذاعة المغربية ترافقكم 93 ساعة في اليوم

about the authors and editors

about the authors and editors

ROWLAND ARCHER — RALEIGH, NC

Rowland is 37 and has enjoyed 18 years of marriage to Libby. For the past 12 years they have lived in North Carolina where Rowland works for Data General as VP of Software Development. They have two young daughters and Libby's current full-time job is raising them.

Rowland first got interested in shortwave radio as a pre-teen, stumbling over HCJB and the BBC on an old Atwater Kent radio. He soon upgraded to a Heathkit GR-54 and verified 95 countries before putting the hobby aside during the last year of high school and throughout his college career. He resumed the hobby in 1980, and now uses an NRD-515 and numerous accessories. His main interest is tropical band DX, and he enjoys hunting Latins, Indos and African stations. Rowland edits the DXer's Forum column for the NASWA Journal, and he is also a member of Fine Tuning and ODXA.

GUY ATKINS — ISSAQUAH, WA

Guy is 34 and married to Rochelle. He is employed by Zetec Inc., a manufacturer of nuclear power plant safety inspection systems used worldwide. Previous to Zetec, Guy spent 9 years in graphic arts and advertising. His wife currently works part-time for an advertising agency specializing in high technology accounts.

A battered Sears Silvertone portable was responsible for Guy's first enthusiasm in radio at age 13. His DXing interests began in 1982 when he met other SWBC hobbyists in the Seattle area. Guy enjoys combining DXing and graphic arts; he has promoted the DXing hobby in the Pacific NW through publication of the Cascade Mountain DX Club newsletter and DX/Northwest's Grayline Report. He has also hosted social activities for Seattle area DXers and organized DXpeditions. Guy currently is on staff with Fine Tuning, assisting with Special Publications. His receiving equipment includes a JRC NRD 525 with a Kiwa Electronics' Multiband AM Pickup (MAP), and a Sony IFC-2010 portable. Guy enjoys receiver modifications, DXpeditions, and antenna experimentation. His favorite DX targets are the South Pacific and Africa. Both Guy and his wife are big fans of popular African music, an interest that grew out of the challenge of DXing Africa from the Pacific Northwest.

KEVIN ATKINS — PINSON, AL

Kevin is 30 years old, has 1 wife, 1 son, 1 daughter, 5 radios, and no desire to add to those totals, thank you! He supports these dependents by managing Communication Arts, Inc., a typography studio serving the Birmingham advertising community. He majored in journalism at Auburn Univ and the Univ of Ala at Birmingham.

Kevin serves the **fine tuning** organization as co-editor of the newsletter, and is a member of the Proceedings editorial staff. He is a NASWA member and chairs that organization's Graphics Committee, which designs and produces material for the monthly Journal and various special projects. Other club affiliations include OZDX and DX South Florida.

Kevin's first DX-love is Indonesia, with Andean South America (particularly Bolivia) running a close second. He is an avid DXpeditioner, and if he finds out where you live, he may show up on your doorstep with a sleeping bag and a BIG roll of wire one day. He also enjoys reliving his childhood at the dials of his son's Lafayette HE-10. His current NASWA country totals are 207 HIC, 183 VIC.

JOHN H. BRYANT — STILLWATER, OK

John is 49 and has been married to Linda for 26 years. They have one child, Mary Ellen, who is currently a senior in college. Although John's home town is Stillwater, OK (their current QTH), John and Linda lived in Arizona, Illinois and Alabama before returning home a decade ago. John is Professor and former Head of the School of Architecture at Okla. State Univ. John is widely known as an expert on the traditional architecture of East and Southeast Asia. In the mid-1970's, the Bryants spent a year in Japan where John was a Senior Fulbright Research Scholar. John has traveled extensively in China, both as a member of official US delegations and as a lecturer at a number of Chinese universities.

John has had 2 careers in the DX hobby. The first was as a teenager in 50's. John began in 1952 as a SW DXer but spent most of that era as a "medium waver." His best catch was 1YZ, Rotorua, New Zealand on 800 KHz in the winter of 1959. His second career, mostly SW this time, began in 1979-80 with the purchase of a Sony 2001. He currently operates a highly modified NRD-525 coupled with a semipermanent 1200' Beverage pointed at the China coast and Sumatera. Although he is enthusiastic about DX from anywhere, John couples his "real world" interests with his DX interests by being absolutely obsessed by DX from East and Southeast Asia. His other radio interest include antenna and propagation experiments. His current total are 200 countries heard/185 countries verified from the "modern era." John is the Editor of Special Publications for Fine Tuning.

DAVID M. CLARK — NEWMARKET, ON

David is 44 years old, a graduate in history and geography and works as a Director of Systems Development for a major trust company in Toronto. He and his wife Elena have 4 children and reside on a 10 acre wooded property in the country, site of Clark's infamous "DX Barn" and antenna farm.

With more than 30 years in the hobby, David concentrates on Indonesians and other transpolar DX on the Tropical Bands. This complements his special interest in the technical aspects of "low-band" propagation. Although he still has an affinity for vintage tube-type gear, his primary receiver now is the NRD-515. Current SWBC-HIC total is about 200, supported in recent years by an extensive tape collection which he enjoys in lieu of QSLing.

David is the Chairman of the Ontario DX Association and also edits the "World Radio Report" column for the club bulletin, DX O)ntario. He is also a member of CIDX, NASWA, NU and FT.

HAROLD CONES — NEWPORT NEWS, VA

Dr. Harold "Dr. DX" Cones is a Professor of Biology and Chairman of the Department of Biology, Chemistry and Environmental Sciences at Christopher Newport College in Newport News, VA. Trained as a biological oceanographer and benthic specialist, Dr. Cones classifies himself as a Field Biologist and prefers to spend his teaching time outdoors rather than in a classroom. He conducts 10-day extended ecology field trips (camping) to Maine in the spring, and Florida in the winter. He is 47, has been married to a high school librarian for 25 years, and has two daughters ages 18 and 15.

Harold began DXing in 1957 with a BC-312 tank radio, dropping in and out of the hobby until 1983 when he again began DXing in earnest. He uses a Hammarlund HQ 180A, a Yaesu FRG-7700 and a Drake R-4B, and loves to DX on old tube equipment including the Knight Kit Space Spanner, Ocean Hopper and Star Roamer. He is Editor in Chief of THE JOURNAL OF THE NORTH AMERICAN SHORTWAVE ASSOCIATION and has published a number of articles in it, as well as other hobby publications. Harold's favorite area of DX specialization is the far Pacific, however he will chase anything in the Tropical Bands. He has earned 40 FRENDX awards, heard 223 NASWA countries, and verified 214. Harold conducts the North American DX Championships each year and is the program chairman for the Annual Winterfest. In addition to NASWA, Harold is a member of the Great Circle Shortwave Society, FT, NU, and the Old Dominion DX Association.

CHUCK DACHIS — AUSTIN, TX

Chuck's involvement in radio and electronics has been life long, mostly self taught, and is instinctive in nature. He was born Oct. 4, 1942, in Minneapolis, MN at the zenith of classic radio production. His family moved to Silver Spring, MD in 1949, where he received his first ham radio license in 1957. He graduated from Montgomery College with an Associate of Arts degree in electronics in 1963. In 1964 he moved back to Minneapolis on his own and had a number of jobs with large electronic firms. In 1973 he moved to Austin, TX (the current QTH) and got involved in rental property ownership and management. He has owned several small businesses (one at a time), but the rental property has been the mainstay.

Chuck had been collecting and restoring classic radios for years, but began his exclusive collection of Hallicrafter products in 1974. Since then he has developed a world-wide reputation as "The Hallicrafter Collector," and the leading authority on the Hallicrafters Company and its equipment. He is also documenting historical information on the company and products, writing articles about Hallicrafters, and restoring these products. He is currently compiling information in preparation for writing his book on Hallicrafters, which will contain interesting and previously unknown information about the company and products. His other interests include listening to classical music, doing public service volunteer work in the battle against AIDS, owning a small antiques and collectable shop, and doing slide shows about Hallicrafters.

RICHARD A. D'ANGELO — WYOMISSING, PA

Rich is 40 years old, a native of Brooklyn NY, and has been married to Susan for 17 years. They have 2 children, Adam and Jennifer, ages 10 and 7 respectively. Rich received a BS in Economics from Brooklyn College in 1972 and his MBA in Finance from Pace Univ. in 1976. Currently, he is employed by Metropolitan Edison Company, an electric utility, as a Manager in the Rate Department.

Rich began DXing in 1964 when he discovered his brother's Hallicrafters S-85 in the basement. His current receiver is an Icom R-70 which is used with an Alpha Delta DX SWL Sloper antenna. Rich has been an active member of many DX clubs over the years and has been a member of NASWA since the first all-SWBC issue in August 1966. He is Manager of the recently created NASWA Company Store and he was recently named the new Awards Program Chairman. Rich also serves in a variety of capacities for SPEEDX--a member of the Board of Directors; a member of the Editorial Committee and as ANARC Representative. Rich is the World DX Club's North American Representative and writes a column for the club's bulletin about the North American radio scene. Other club/hobby affiliations include ODXA, NRC, A*C*E, DSWCI, OZ DX, DX Australia, the DX Spread, FT and NU. He was the Chairman of the Administrative Committee for the first 2 North American DX Championships (1987 and 1988) and is currently chairman of the recently formed joint NU/FT Special Transmissions Committee.

Rich focuses primarily on shortwave broadcast DXing. His major listening interest is Latin America although Africa and the Pacific region have been favorites over the years.

GORDON DARLING — PORT MORESBY, PAPUA NEW GUINEA

Gordon is 42 years old, married to Jean and with two harmonics. The harmonics Heather and Naomi are 16 and 10 respectively. Apart from the children the Darling household has two dogs, two cats and a cuscus (a form of PNG possum). Gordon has worked in Papua New Guinea for six years in the Spectrum Engineering field with the Post & Telecommunications Corporation (PTC). The Spectrum Management Department of PTC being Papua New Guinea's radio regulatory body similar to the FCC in the US or the DoC in Canada. Prior to moving to Papua New Guinea, Gordon worked with the BBC Monitoring Service for over eight years. Gordon has been fortunate in being able to combine a hobby in radio with a career in radio monitoring. On the hobby side, Gordon's initial introduction to DXing was at the age of 14. Interest has never waned since then and Gordon's interest encompasses DXing in most facets of the hobby (BCB/MW, SW, Ute). However, tropical band DXing remains his major interest. Current NASWA HIC/VIC total is 234/229. Gordon's other hobbies include traveling, reading, and brewing his own beer. In addition to his listening interests Gordon also holds the amateur call P29ZGD. Equipment currently in use includes a Yaesu FRG7700, Kenwood R5000, Kenwood TS440S, and the Sony ICF-2001D. Antennas always tend to be in a state of flux as the Darling antenna farm is constantly being experimented with. Currently the antennas are two sloping Delta loops as the main antennas and various longwires and active antennas.

GERRY L. DEXTER — LAKE GENEVA, WI

Gerry has been a SW enthusiast for nearly 40 years. His main areas of interest are Latins, clandestines and QSLing. He just recently passed 1400 SWBC stations QSL'd (using NASWA guidelines). Gerry has written widely about aspects of the hobby including several books on QSLing techniques. Dexter writes the "Listening Post" and "Clandestine Confidential" columns monthly in Popular Communications as well as feature articles for that and other magazines and also edits a newsletter covering clandestine stations.

After a career in commercial broadcasting, Gerry transitioned to full time writing, editing and publishing. Since the early 1980s, he has operated Tiare Publications which has published nearly three dozen books on SW listening, ham radio and scanner monitoring.

When not envolved in radio, Gerry can often be found with his extensive collection of classical jazz records. Gerry and Sharon have one son, Don who an electronic/computer engineer.

JOE FARLEY — DOWNERS GROVE, IL

Joe is 37 years old. He and his wife Susan reside in the Chicago suburb of Downers Grove with their children Andy (4) and Juli (2). Joe received a BSEE from Northwestern Univ. in 1977, and manufactures medical and industrial x-ray tubes for a living.

Joe has been DXing on and off since 1967, and has current HIC/VIC of 196/153. He is not firmly committed to any one aspect of the hobby, but interests generally include the trop bands, utes (maritime mobile CW), and pirates/clandestines. Since first becoming convinced of their utility, Joe has been a loop fanatic and is interested in investigating possible hobby applications of loops in the areas of DXing, DFing, and null and beam steering.

When not DXing, Joe's other interests include cabinetmaking, fiction, ice skating and teach hockey.

NICHOLAS HALL-PATCH — VICTORIA, BC

Nick is starting to push middle age, is married to Susan, and has 2 daughters, aged 11 and 8, who have been known to assist in Beverage expeditions under the guise of "camping trips." He is a self-employed gardener in Victoria, the City of Gardens, and what with raising plants and children, has little spare time.

However, Nick has an ongoing interest in improving his MW DX reception. He DX'ed MW in the mid-60's, and then again since the early 70's. He has indulged in a good deal of experimentation with receivers and antennas since then. Nick has been Technical Editor of the International Radio Club of America since 1978, and was editor of IRCA's A DXer's Technical Guide, published in 1980 and 1983, and in German translation in 1987. He is also a member of CIDX and LWCA, and is a radio amateur, VE7DXR. Mongolia and Bulgaria are among the better MW catches from his QTH, but most good DX is now heard using Beverage antennas on expeditions to the Pacific coast. He prides himself on never having seriously DX'd with a stock receiver, and presently uses a receiver of his own design and construction.

DON JENSEN — KENOSHA, WI

Don has been an active DXer since 1947, when, at the age of 11, he was introduced to radio by his father, a sometimes bootleg "ham." Even at that tender age he was intrigued by geography and far-away places. He found it a marvelous adventure to sit at home and tune in places like Quito, Ecuador, and Bern, Switzerland, his first two DX catches. While he dabbled in different aspects of the listening hobby over the years, his primary interest has remained SWBC. He has been active in the hobby in numerous ways. In 1964, he founded and was the first executive secretary of the Association of North American Radio Clubs

(ANARC). He has held editorial and administrative posts in a number of radio clubs, including NASWA for the past 25 years. From 1969 through 1989, he published and co-edited the Numero Uno DX weekly, and remains editor emeritus of that publication. He has been a freelance magazine writer since 1963, and currently is contributing editor of POPULAR ELECTRONIC's "DX LISTENING" column. For more than a quarter century his columns and articles have appeared in a number of radio magazines. For a number of years he edited the now-departed COMMUNICATIONS WORLD magazine. He also has had regular SW features aired on various DX programs around the world, and currently contributes DON JENSEN's JOURNAL bimonthly on RADIO CANADA INTERNATIONAL's "SWL DIGEST."

Don formerly was employed in broadcasting, in television and, later, as a radio news director. For 27 years he has been a newspaperman, copy editor and staff writer for the daily Kenosha News. He is married to Arlene, also a journalist, and they have three children, ages 21 to 33. They live in Kenosha, WI.

FRITZ MELLBERG — HAWARDEN, IA

Fritz is 45 and is a pastor of the United Church of Christ congregation in Hawarden, Iowa, a small town north of Sioux City. He is married and has 2 teenage girls. He grew up in Menasha, WI and worked for the Appleton (WI) Post Crescent while in college at the Univ. of Wisconsin. He worked as a writer and PR person for his denomination's office of communication in New York City where he learned how to edit by being so ruthlessly edited by others on the staff.

Among his current hobbies are woodworking, sculpting, and collecting old radios, parts and literature. He has a large collection of old tubes as well as a few working Atwater Kents and Philcos, and enjoys learning to repair these old classics. Fritz also works as a therapist for a local substance abuse clinic and, to keep sane, collects classic jazz and rock albums.

He bought his first SW radio to keep up with the Green Bay Packers while in India back in 1968, but it wasn't until 1979 that he began to DX seriously. He has been a member of the major DX clubs and currently spends his time DXing on the broadcast band. He advocates tape collecting as an alternative to QSLing, but admits he is not a purist and proudly displays his 3 QSLs!

CHUCK MITCHELL — INDIANAPOLIS, IN

Chuck began his DX listening career in 1973 at the age of 13. One year later he earned a novice license and took to the air as WN9NWF. SWBC QSL collecting and DXing and HF ham bands were fascinating to Chuck in these beginning years. Current hobby interests include tropical band listening, antenna experimentation and QRP (less than 5 watts out) DXing on the ham bands. Chuck prowls the ham frequencies as WB9NWF with an advanced ticket.

Professionally, Chuck works as an audio engineer at a commercial recording studio in Indianapolis. He has worked and studied in various parts of the globe including Monaco, Brazil and the Dominican Republic. In addition to DXing and work, Chuck keeps occupied with cycling, backpacking, photography, playing guitar and computers.

DON MOORE — BIG RAPIDS, MI

Don is 33 years old. Originally from PA, he received a BS from Penn State in 1980. From 1982-84 he worked with the Peace Corps in a rural Honduran high school. While there, Don made several trips to Guatemala and Mexico, and met his wife, Theresa Bries, also a Peace Corps worker. In 1985 they spent 6 months traveling in South America. In 1989 they received MA's in Linguistics/TEFL at Ohio Univ. and began teaching English to international students (mainly Latin American and Japanese) at Ferris State Univ. in Michigan. Don doubles as Activities Director for the program.

Don began DXing in 1971, and has been more or less active ever since. Although he dabbles in just about everything, his main interests are SWBC and MW, especially Latin American stations. During his Latin American travels, he has visited over 100 radio stations. He enjoys QSL collecting from both big and small stations, and is especially proud of his collection of over 120 different HCJB QSLs. He has over 1000 SWBC stations heard and over 500 verified. Other interests include folk music of all types, history, science-fiction, gardening and camping.

GENE PEARSON — PERRYSBURG, OH

Gene is 44 years old, married, and has 2 daughters aged 22 and 16. He is a priest in the Episcopal Church with 17 years service.

Gene began DXing in 1958 as a 12 year old in Birmingham, AL with a Knight Kit Space Spanner. In 1963, he left his SX-110 at home when he entered the Univ. of Virginia. However, he had his receiver with him during graduate school in philosophy (Ann Arbor, MI) and theological seminary (Chicago, IL) between the years 1967-72. Then, after 15 years inactivity as a DXer, he became active again in 1987.

The Pearson listening post includes an NRD-525, two R-390A's (plus 1 1/2 R-390A's for parts), an LF Engineering L-101 Converter and an L-201 VLF Preamplifier. A Sherwood Engineering SE-3 PLL Detector and a Hammarlund HC-10 augment the two R-390A's. His main interests include Tropical Band SWBC, LWBC, long and MW Non-Directional Beacons, and the informal study of propagation and antennas. His newest love is the restoration of homeless R-390's to their full potential. During his first period as a DXer, Gene was a member of the Newark News Radio Club and the Universal Radio DX Club, and he reported also to Hank Bennett's column in Popular Electronics as WPE4AIX. Today he is a member of NASWA, ODXA, LWCA, and FT.

BRUCE PORTZER — SEATTLE, WA

Bruce is 39 years old and married to Evelyn, with a 3 year old daughter, Theresa. He works as an electronics engineer for a consulting firm, where he designs security and communications systems for jails, courthouses, office complexes, convention centers and other large architectural projects.

Bruce began DXing in 1964. He has been an avid MW DXer since then, and has heard 70 countries on MW with 43 verified. His current receiving set-up includes a Racal RA-17 and a Yaesu FRG-7 with a Radio West loop. He also manages to fit in a couple DXpeditions each year to the Washington or B.C. coast to look for transpacific MW DX. He has been a member of the International Radio Club of America since 1966, and was editor-in-chief of their bulletin, DX Monitor, for 10 years, plus DX Worldwide editor and president for a couple years each. He is also a ham (N7ECJ) and likes to work DX on the 40, 20 and 15 meter bands.

R. CHARLES RIPPEL — VIRGINIA BEACH, VA

Chuck is 36 years old and is married to Beth and has one 7 year-old daughter, Ashley. After a period of employment with Northrup-Page Communications Engineers, Inc. assigned to the Saudi Naval Expansion Project, Chuck became and currently holds the position of CEO for Great Atlantic Information Systems, Inc. in Virginia Beach, VA. He also consults to the commercial broadcasting industry and is a member of the Society of Broadcast Engineers, a professional society.

Chuck began DXing in 1972 with a Realistic DX-150 and was introduced to NASWA by Edward Shaw. He is one of the founding members of ODDX, the Old Dominion DXer's Association based in Tidewater, VA. In 1974, he edited the CIDX column "At Random" and in 1987, he created DXer's Forum for NASWA. Chuck was Chairman of the NASWA Editorial Committee till Sept. 1988, until his appointment as Executive Director of NASWA which he held until Feb, 1990. Over the years, he has contributed several articles to FRENDX including papers on Antenna Noise Bridges and Delta Loop Antenna theory and construction techniques. This is Chuck's third effort with PROCEEDINGS, the prior years contributing to the Papua New Guinea articles and writing the engineering review of the Marantz tape recorder. This is also Chuck's third year serving on the Proceedings Editorial Review Committee where he edited the technical articles.

Chuck currently uses an JRC NRD-525 and a Sony 2010 and has restored a Hammarlund HQ-180 and an HQ-145. Antennas include a 130' Inverted Vee fed with open wire and matched with a Nye-Viking tuner. His main DX interests include SWBC from the South Pacific, Asia and Africa. Chuck holds a number of NASWA awards including: Senior Papua New Guinea DXer (007), European Senior DXer (019), Ecclesiastic DXer (003), Emissora Nacional DXer (003), All Continent QRP DXer (001), and Senior Nigerian DXer (002).

MITCHELL A. SAMS — WICHITA, KS

Mitch is 30 years old, married and the father of Matthew (3) and Molly (14 mo.). His wife Sherri is a kindergarten teacher. Mitch received a BSEE from the Univ. of Arkansas in 1983 and works as a Radar Systems Analyst for Boeing Military Airplane Company in Wichita, KS. When not DXing, Mitch and Sherri enjoy fishing, snow skiing and travel.

Mitch began DXing in 1972 when, as a Florida 5th grader, he was given a Revell SW radio kit as a birthday present. He's been fascinated ever since! Currently, he uses a modified FRG-7 and a modified HQ-180A. Mitch founded Ozark Mountain DX Club in 1980. OMDXC merged with Fine Tuning in 1986. Mitch now serves as Managing Editor of Fine Tuning. Using the NASWA radio country list, Mitch's totals stand at well over 200 heard and 180 verified. He especially enjoys DXing Indonesia and Asia. However, as his loggings show, Mitch enthusiastically DX's all areas of the world, occasionally spending time of MW, as well.

HAROLD SELLERS — NEWMARKET, ON

Harold is another Baby Boomer at 37 years of age. He has been married to Linda for 14 years and they have two young children, Raelene and Brent. His training is as an electronics technologist and he works as a Communications Maintenance Specialist in Air Traffic Control Systems for the Canadian government's Department of Transport. His work takes him around the province of Ontario. Living in Newmarket, a town of 40,000 people 40 km north of Toronto, Harold finds this to be a good DXing location and it is actually very close to his childhood home where the DX bug first bit.

Harold has been DXing since 1968 and presently specializes in SWBC DX, both tropical and international bands. Approximately 190 countries have been heard, with over 150 verified. He has been a club editor and/or executive for 20 years and presently serves as the Managing Editor and General Manager for the Ontario DX Association. Harold is one of the founders of the ODXA and served as Chairman of the club from its founding in 1974 to 1990. The receiver at present is a Japan Radio NRD 515.

CRAIG SIEGENTHALER — SEATTLE, WA

Craig is 39 years old, married to Nancy and is currently the President/Chief Engineer of Kiwa Electronics that manufactures the MAP--Multiband Am Pickup. Craig contracted the radio bug at an early age with the construction of a Heathkit (Griefkit) shortwave receiver. He has since been a licensed ham, studied electrical engineering, and has spent most of his adult working life as Chief Engineer/broadcast consultant, constructing and maintaining AM and FM radio stations in the US and the Caribbean.

Craig enjoys listening to distant broadcast stations with unusual music programs. His other interests include traveling, swimming, scuba diving and hatha yoga.

KENT WILLIS — LOUISVILLE, KY

Kent is 29 years old and a professional electronics engineer. He is currently involved in the design and development of sophisticated intrusion detection systems for the US Navy. He and his wife Judith have 1 cat, no children and many orphaned radio receivers, including a completely solid state Collins R-392 Kent modified while an undergraduate at the University of Louisville.

Kent began DXing in 1975 with a Radio Shack "Globe Patrol" kit receiver and will never forget hearing Radio Nederland and HCJB for the first time. Current different countries heard for all frequencies are about 220, with 195 SWBC with about 160 verified. The rest are medium wave and CW utility stations. Radio related interests include ferrite rod directional antennas for AM and SW applications and chasing 60 and 90 MB African DX.

Kent is a member of SPEEDX and edits "Technically Speaking..." for them. He is also a member of NASWA and FT.

CEP